

Popular Science

FOUNDED **MONTHLY** 1872

INVENTIONS
DISCOVERIES
RADIO
AUTOMOBILES
AVIATION
HOME WORKSHOP



FRANK
MURCH

OCTOBER

Strange new gas masks to protect animals in warfare

25 CENTS

Beginning—The Story of Houdini—Page 16

Now! Quality at a New Low Price

The Perfected C-H Rheostat

Designed to radio engineers' specifications. Revolving drum type with one hole mounting. All spring tensions adjusted at factory and undisturbed by mounting. Instrument cannot turn on panel. Very small size—less than $\frac{1}{4}$ inch back of panel and narrower than standard socket. Operation smooth and quiet. 6 ohms, 15 ohms, and 30 ohms—perfect control for all tubes and their combinations.

C-H Radio Potentiometer

Similar in construction to the perfected rheostat. 400 ohms and only a little larger than a silver dollar. Perfect, smooth operation—no back lash or sticking. Price \$1.00.



Operating parts built as unit—the C-H Perfected Rheostat is not dismantled for mounting on panel. Rheostat is locked in place and knob positioned without a single set screw.

The C-H Low Loss Socket

The revolutionary socket design that created a sensation everywhere. Thin ORANGE Bakelite shell. Base of heatproof Thermoplas—terminals cannot loosen under heat of soldering iron. Contacts grip both sides of each tube prong and are SILVER plated to prevent corrosion losses. Preferred by careful builders at 90c—now 60c because of huge production savings.



C-H Radio Toggle Switch

The newest idea in panel switches. ON or OFF with a flip of the finger. Beautiful appearance and simple one hole mounting—neat etched plate for panel provides definite indication. Quiet, easy operating switch mechanism.



The C-H Radio Switch

The original radio switch. Millions in use. One hole mounting—high capacity mechanism. The only radio switch approved for 110 volt circuits by the Underwriters Laboratories. Ideal for batteryless sets or higher voltage circuits. Many switches now have buttons to look like the C-H but the patented mechanism cannot be duplicated. Demand the orange and blue box for satisfaction.



The C-H Radioloc

The radio switch that locks with a key. Just the thing for the home with children—for the protection of tubes and batteries. One hole mounting—quiet operation. Like all C-H radio parts, packed in orange and blue boxes. Look for them—and the C-H trade mark.

The name Cutler-Hammer has held an enviable position in radio. Consistently from the earliest days has the C-H trade mark been synonymous with proper design and unusual precision. Radio builders everywhere justly had faith in these foremost engineers and millions of their radio parts in the orange and blue boxes have helped build receiving sets of quality.

Better Sets at Lower Cost

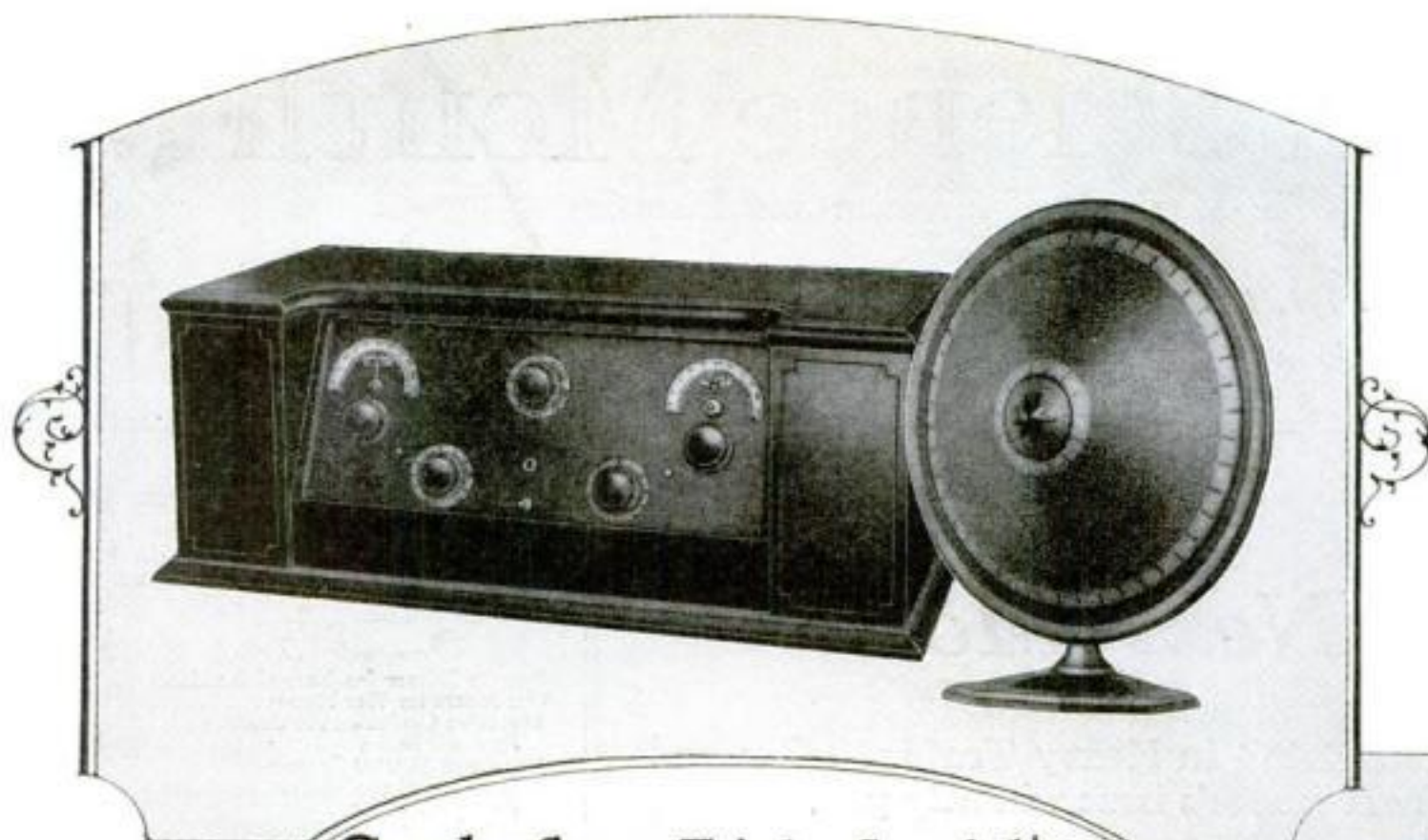
These millions of sales have brought down manufacturing costs and today this quality carries no premium. Demanding the C-H trade mark now not only insures satisfaction, but provides a saving. Dealers everywhere are ready to serve you. If yours has not yet stocked any C-H part you desire, send us his name and we will see that you are supplied.

THE CUTLER-HAMMER MFG. CO.

Member Radio Section, Associated Manufacturers of Electrical Supplies
MILWAUKEE AND NEW YORK

CUTLER-HAMMER

Buy Your Radio Parts by Name



Crosley Super-Trirdyn Special \$60.

Crosley Musicone \$17⁵⁰

3 Tubes Now give Results Equal to 5

SOUNDS improbable doesn't it? But it is a scientific truth, first demonstrated in the Crosley laboratories and then confirmed by the performance of thousands of Trirdyns the country over.

Employing but 3 tubes, the Crosley Super-Trirdyn consistently equals 5 and often surpasses, the more costly 5 tube sets in performance.

These astonishing results are simple to explain. Instead of passing the incoming signal *once* through each of 5 tubes, Crosley design passes it through two of the three tubes *several times*, each time building up its strength and adding to its volume.

Even the technically uninitiated can see the advantages: simplicity instead of complexity; fewer dials to adjust; sharper accuracy in selecting stations; greater clarity; greater volume.

Yet that is not all. Simplicity of design and fewer parts make manu-

facturing costs lower and bring about a lower cost to you. This, combined with the economies of gigantic production makes it possible to offer this quality receiver, the Super-Trirdyn, at this remarkably low price. For Crosley is the world's largest builder of radio sets—owning and operating parts factories, cabinet woodworking and assembly plants.

Listen to a Crosley Super-Trirdyn under the most exacting conditions. Make an unbiased comparison with the most costly receiver you have ever heard. Forget the radical difference in price.

Then will you understand why the Crosley Super-Trirdyn represents a genuine achievement in radio performance and value which all America was quick to recognize and reward with increasing sales.

Write for attractive illustrated catalogue. Authorized sales and service stations everywhere.



Super-Trirdyn De Luxe Combination

Super-Trirdyn De Luxe	\$ 60.00
Musicone De Luxe	27.50
Console Table	25.00
Complete	\$112.50

**ADD 10% TO ALL PRICES WEST
OF ROCKY MOUNTAINS**

Crosley manufactures receiving sets which are licensed under Armstrong U. S. patent No. 1,113,140 and priced from \$9.75 to \$60.00 without accessories.

Crosley owns and operates WLW first remote control super-power broadcasting station.

CROSLEY

BETTER—COSTS LESS

RADIO

THE CROSLEY RADIO CORPORATION, CINCINNATI, OHIO

© This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Popular Science Monthly

The Magazine of Invention and Discovery

OCTOBER, 1925; Vol. 107, No. 4

25 cents a Copy; \$2.50 a Year



Published in New York City at

250 Fourth Avenue

Coming Next Month

Do You Have Trouble Driving in Heavy Traffic?—Gus and Joe's valuable hints in next month's issue will help you.

How to Use Glue in Your Home Workshop—A national authority on glue and its uses offers practical advice on how to insure joints that will hold in doing common household repairs, or in building furniture and doing other wood work.

The Last Word in Radio—New facts about low-loss coils from the Radio Laboratory of the Popular Science Institute of Standards; how to build a good crystal set; hints for installing a commercial receiver—all in next month's Radio Department.

More than 200 other fascinating articles and pictures, giving you all the news of radio engineering, science and invention, strange and unusual things people are doing, together with practical ideas for the automobile, the home, the home workshop, and the use of tools and machinery.

HOUDINI, the most mysterious man in the world, begins his own fascinating story in **POPULAR SCIENCE MONTHLY** next month — a chronicle frankly revealing astonishing secrets from a life packed with magic and romance. When you read Raymond J. Brown's vivid picture of Houdini the man, on page 16 of this issue, you won't want to miss a single word of this amazing series, starting in the November number.



Houdini (right) explaining tricks of fraudulent mediums to Raymond J. Brown, whose fascinating character portrayal of the world's most mysterious man appears on page 16 of this issue. Houdini's own story begins next month

POPULAR SCIENCE MONTHLY

Issued monthly. Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, \$2.50; foreign countries, \$3. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dunellen, N. J. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1925, by the Popular Science Publishing Co., Inc. The contents of this magazine must not be reprinted without permission. In presenting in its editorial columns numerous stories of new products of applied science, **POPULAR SCIENCE MONTHLY** does not underwrite the business methods of the individuals or concerns producing them. The use of **POPULAR SCIENCE MONTHLY** articles, or quotations from them for stock-selling schemes is never authorized.

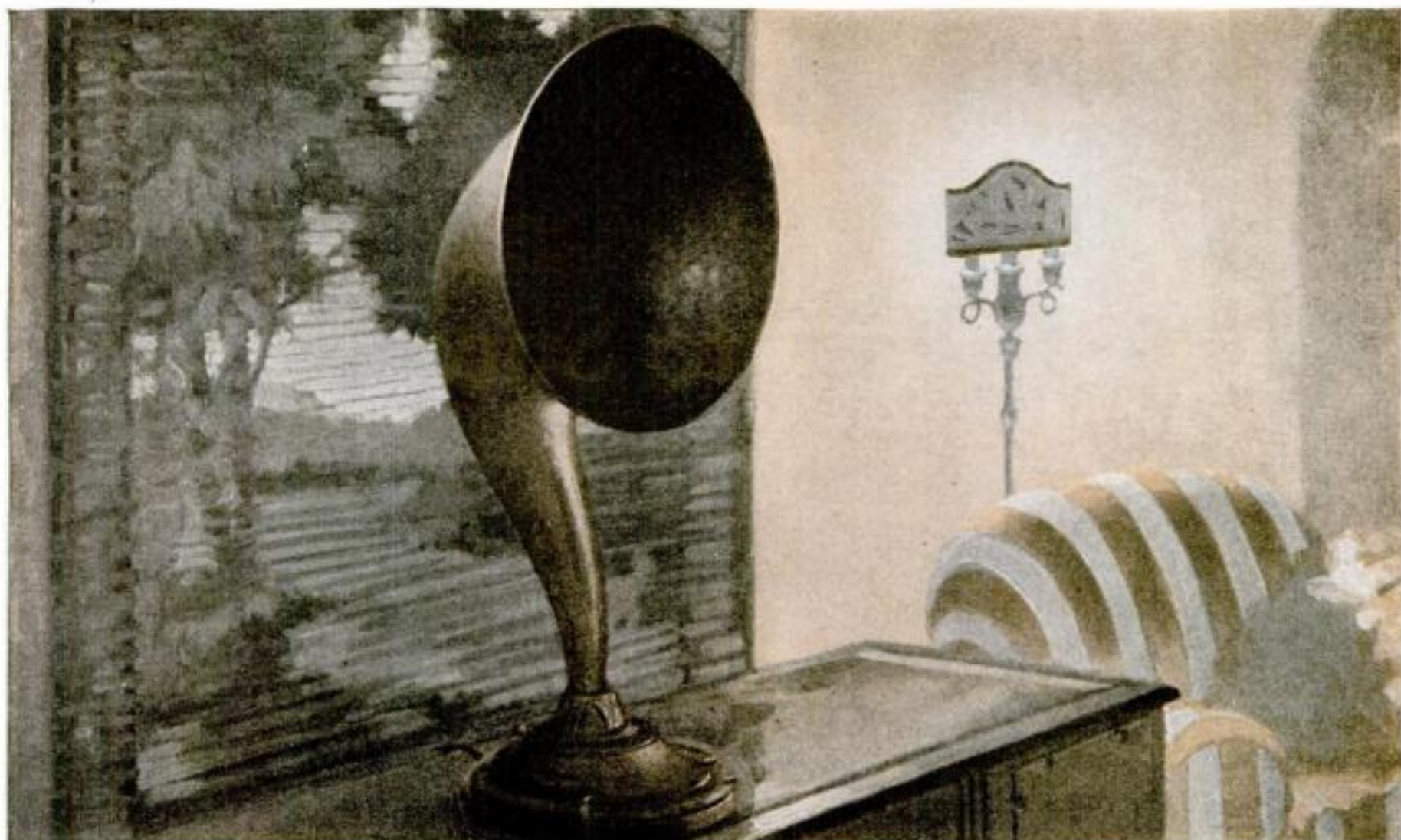
O. B. Capen, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Secretary.

In This Issue

	Page
Popular Science Institute of Standards	6
Gas Masks for War Horses	9
Inventive Genius on the Gridiron	10
By Iunir Brown	
Our Great \$10,000 Contest	12
A Romance of the Microscope	13
By Peter Fischer	
Giant Mother of Airplanes	15
Houdini—The Most Mysterious Man	16
By Raymond J. Brown	
Uncle Sam's Cruising Repair Shop	18
Some Snares for Inventors	19
By Frank Parker Stockbridge	
A Woman Blacksmith	21
Now Science Mines the Ocean	22
By Edgar C. Wheeler	
A Mechanical Doctor for Motor-Cars	24
By Fritz Bloch	
Just What Is Evolution?	25
Our Hidden Poes in the Air	27
By Newton Burke	
Can Man Reproduce the Sun?	28
By Frederic M. Delano	
An Ice-Locked Island of Mystery	30
How to Pick a New Boss	31
By Samuel S. Board	
Army Tests "Flivver Cavalry"	33
He Puts His Hand in the Lion's Mouth	34
By Robert E. Martin	
New Mileposts of Discovery	36
Safety at the Switches	38
Simple Water Turbine	38
New Color-Sorting Machine	39
Bullet-Proof Gas Tank for Airplanes	40
Newest Folding Umbrella	40
Chewing Machine Tests Beef	40
Novel Gravity Scales	41
Co-Eds Grow Slim by Machinery	41
Hanging Weight Holds Papers	41
Queer Homes—No Place Like Them	42
Where Science Goes Down to the Sea	43
Device Limbers Pianist's Hands	44
Controls Train 300 Miles Away	44
Model Tower Made of Toothpicks	44
Where the Diver Met Her Shadow	45
A Portable Machine-Shop	45
Smallest Lighthouse Model	45
Story of Bees in Movies	46
Nest of the Largest Bird	46
Mouselike Deer from Ceylon	46
Railway to Be Roofed by Boulevard	47
Sky Traffic and Its Progress	48
Curiosities from the Motor World	49
Newest Trousers Press	50
Invents Painless Slaughter Gun	50
Self-Feeding Shaving-Brush	50
Clothes and Hat Brush in One	51
Watch-Chain Safety Catch	51
Toothbrush Holder a Sterilizer	51
Outfit Replates Silver at Home	52
Houses of Steel, Cork, and Concrete	52
Unsinkable Bathing-Suits	52
Device Controls Sound Waves	53
Guarding against Earthquakes	53
Sails 202 Miles on a Mattress	53
Modern Utensils for the Home	54
Home Fire Alarm	56
Warning Traffic Signal	56
Carves "Last Supper" in Wood	56
New Safety Door Lock	57
A Clawhammer Ax	57
Handkerchief-Cutting Machine	57
What Set Shall I Build?	58
By Alfred P. Lane	
New Life for Your Radio Tubes	60
Newest Inventions in Radio	61
How to Charge Your Batteries	62
By John Carr	
For Well Equipped Cars	63
Gus Reveals Some Tire Secrets	64
By Martin Bunn	
Useful Hints for Autoists	68

The Home Workshop 71
Better Shop Methods..... 74

And Other Timely Articles and Pictures



The Brandes Speaker—Type H—a simple, attractive, quality horn with a smart antique finish. Adjustable . . . \$18.

Acoustics by Brandes

ACOUSTICS is the science of sound. Radio acoustics is the science of transforming electrical impulses into audible sound—the new and absorbing study of *real* reproduction of voice and music. And in this field Brandes have been pioneers since 1908.

Today, along with an era of remarkable new speakers by Brandes, has dawned an epoch of Brandes acoustics built into better radio sets.

So, whether you buy a set *and* a speaker or a set with a self-contained speaker, insist on “Acoustics by Brandes” and be assured of finest tone quality and uniformly good reproduction.

The new phonograph attachment—same unit as Type H Speaker. Adjustable. . . . \$10.



Brandes Cabinet Speaker of mahogany in the popular brown finish. Same tone quality and volume as Type H Speaker. Adjustable. . . . \$30.



The Superior Matched Tone Headset to tune in with. To listen undisturbed—and undisturbing. . . \$4.50.

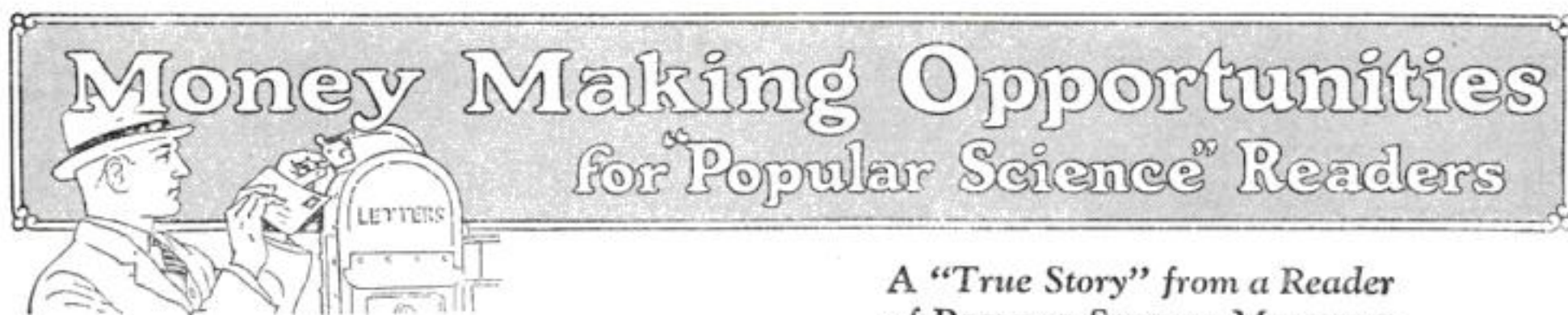


Brandes adjustable Table-Talker with the gooseneck horn. \$10.



Brandes

experts in radio acoustics since 1908



A "True Story" from a Reader
of POPULAR SCIENCE MONTHLY

It Is Easy to Succeed

A WOMAN wrote us a letter with such a big message for every reader of POPULAR SCIENCE MONTHLY that we reproduce it in full. Her letter proves again that it is easy to succeed—if you really want to.

POPULAR SCIENCE MONTHLY:—

The Advertising Opportunity that interests me most is the one that has helped our family.

My husband was a day laborer until he decided to study law. He wrote the School, advertised in your magazine, received his books promptly, studied nights, completed his course, took examinations, and passed.

He still is climbing onward. Was elected to the State Legislature last year and is candidate for Attorney General and has a good private practice. An advertisement fired his ambition and he is still pushing forward.

Mrs. V. E. A.

From day laborer to the State Legislature of Texas! In the clipped phrases of this letter is the material for a three-act drama or a 300-page novel.

Mr. V. E. A. and the tens of thousands of other men who have used special training to raise themselves from the ranks, prove that America is still the land of opportunity. But the opportunities are for the men who *specialize*, the men who deliberately pick out the work they want most to do and then fit themselves for it.

Through its pages of advertising of schools and educational books, POPULAR SCIENCE MONTHLY has started thousands of men on the road to success, big money, and all that big money brings a man and his family.

Whatever you want to be—a lawyer or a master carpenter, a salesman or the owner of a garage, an artist or an electrical expert, a public speaker or a pharmacist—there are schools and books advertised in the MONEY-MAKING OPPORTUNITIES SECTION of POPULAR SCIENCE MONTHLY ready to help you secure the specialized training you need to get ahead.

\$100 in Cash Prizes

For the best letters in answer to the questions:

What advertisement in the MONEY-MAKING OPPORTUNITIES SECTION interests you most—and why?

we will pay \$100 in cash prizes.
For full details—

See Page 146

It isn't hard work to make money. It is a matter of intelligence, of picking out the work you are most interested in, and then fitting yourself for the work you have selected.

The boss doesn't work any longer hours than his men. But at the end of the week he has made twice, three times, or five times as much as the men who work for him.

And at the end of the day, instead of fighting his way into an overcrowded streetcar, he steps into his own automobile and goes home to his family—

a prosperous, successful American business man, with money in the bank and all the good things of life at his command.

If you, too, would have your own car, your own home, and all the other good things of life, determine now to spend the eight hours a day you must work anyhow in doing something you enjoy and be the boss instead of the wage-earner.

Start on page 146 and study every advertisement in the MONEY-MAKING OPPORTUNITIES SECTION. Decide what most you would like to do and then fill in the coupons or

(Continued on page 148)

You will find Scores of Opportunities for Making More Money in the "Money-Making Opportunities" Department, starting on page 146 of this issue.

TRIMO



- all parts replaceable - at small cost! ®

THIS picture shows at a glance one of the big features that makes the TRIMO Pipe Wrench the economical choice of the householder, farmer, master mechanic and American industry. When the INSERT JAW in the handle of the TRIMO becomes worn or dull through many years of service, all you have to do is to spend a few cents for a replaceable jaw instead of buying a new handle which is a large portion of the cost of a new wrench. This same replaceable feature applies to all TRIMO parts, making this rugged tool low in FINAL COST.

But it's the masterly design of the TRIMO that most wrench-wise users admire. Note the NUT GUARDS, for instance, how they protrude slightly above the wheel, thus keeping the wrench in perfect adjustment when used in close quarters or laid down. TRIMO has a STEEL frame that WILL NOT BREAK—your guarantee of safety and durability.

For these and many other reasons, people who KNOW never quibble about paying a few cents more for this—America's super-quality Pipe Wrench. At all hardware, mill and plumbing-supply stores. Insist on TRIMO—accept no other.

The TRIMO is made in eight STEEL handle sizes, 6, 8, 10, 14, 18, 24, 36 and 48 inches; in four WOOD handle sizes, 6, 8, 10 and 14 inches. The 10-inch WOOD handle household size (see small illustration) comes packed in individual cartons.

TRIMONT MFG. CO., ROXBURY, MASS.

America's Leading Wrench Makers
For Nearly 40 Years

Besides Pipe Wrenches, the TRIMO line includes Pipe Cutters, Pipe Vises, Monkey Wrenches and Chain Wrenches. The name TRIMO stamped on any tool is your guarantee of quality.

Raymond E. Hill

How Our Subscribers Make Use of the Institute of Standards

One Day's Mail

Besides letters from all over the United States, the Popular Institute of Standards receives letters from every corner of the world



UNCLE SAM'S postmark is not the only one on the thousands of letters that come to the Popular Science Institute of Standards. Readers from every continent in the world are among those who have taken advantage of the service the Institute offers.

The writers of these letters are interested in different kinds of radio and tool equipment, but they all have the same essential reason for writing to the Popular Science Institute of Standards: They want to "play safe" in their selection of such products, and they know they will be safe if they are guided by a staff of expert engineers when they buy.

The inexperienced, as well as the experienced, realize the advantage of restricting their choice of radio and tool products to ones that have passed rigid scientific tests in the laboratories of the Popular Science Institute of Standards. Men engaged in various fields of radio work, as well as some of the largest dealers and jobbers in radio apparatus in the country, are using the List of Approved Products of the Popular Science Institute as their guide in buying radio equipment. Likewise, mechanics and hardware dealers of many years' experience ask what tools we have approved.

Here is a letter, typical of many that come to the Institute:

I am taking the liberty of inclosing an advertisement from our local newspaper of the — radio set, and I would respectfully request your opinion as to its efficacy.

I have considerable faith in the products approved by the Popular Science Institute and feel that my judgment in adopting the policy of buying only such products has saved me from making serious mistakes. I would therefore appreciate your indorsement before I send the order for this radio set.

—P. B. J., San Francisco, Calif.

A man who is general storekeeper for a railway system writes as follows:

I have read with keen interest of the good work that you are doing with regards to approving tools and radio products that have withstood scientific and practical tests in your laboratories.

Will you be good enough to send me a list of such tools as have met with your approval. This, I am sure, will be of service to me, not only in my business, but for my personal purchases, as I am very much interested in tools of all designs and types and am continually purchasing them.

Before closing, I would like to say it is my opinion you have started something in this work that will be of enormous value to users of tools.—S. O. M., New York, N. Y.

Many readers who have been guided by the findings of the tests of the Popular Science Institute of Standards write later to assure us of the satisfactory service received from the equipment purchased on our recommendation and, almost invariably, they add a statement similar to

POPULAR SCIENCE Monthly Guarantee

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

Popular Science Monthly guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in Popular Science Monthly may expect that these products will give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by Popular Science Monthly.

THE PUBLISHERS.

the following: "I told my friends about the great work you are doing and many of them consulted the List of Approved Products you sent me in making their own purchases of radio and tools."

All equipment approved by the Popular Science Institute of Standards has passed rigid tests made under the direction of Prof. Collins P. Bliss, who is head of the Mechanical Engineering Department and director of Testing Laboratories at New York University, besides being director of the Popular Science Institute of Standards.

Under his experienced guidance, and with \$300,000 worth of testing equipment at their command, a staff of expert engineers is constantly at work testing tools and radio products.

Information regarding the results of these tests is available to all readers of POPULAR SCIENCE MONTHLY. Inquiries and requests for Lists of Approved Products should be addressed to the Popular Science Institute of Standards, 250 Fourth Avenue, New York, N. Y.

IT IS obviously impractical for even as completely organized a bureau as the Institute of Standards to test all products listed in tool or radio catalogues advertised in our columns. Only tool and radio products specifically advertised in POPULAR SCIENCE MONTHLY are tested and approved by the Institute.

Send for List of Approved Products

POPULAR SCIENCE MONTHLY will be glad to furnish on request a list of Radio and Tool Manufacturers whose products have been approved by the Institute, after rigid laboratory tests.



new **ULTRADYNE**

MODEL L-3



To protect the public, Mr. Lacault's personal monogram seal (R. E. L.) is placed on the assembly lock bolts of all genuine Ultradyne Model L-3 Receivers. All Ultradynes are guaranteed as long as these seals remain unbroken.

No Dials-No Panel Built-in Loud Speaker

IF the Ultradyne Model L-3 were merely another new receiver, its influence in the industry would be little felt.

But it is in reality the first step in the general revision of radio receiver design which is bound to follow its advent.

For the new Ultradyne Model L-3, is an entirely new type of receiver—radically different in appearance and method of operation—gives finer results from finer engineering. Employs six tubes—is completely assembled and wired, ready for the tubes and batteries.

It has no dials—no panel—no needless controls. Two levers, an exclusive Ultradyne feature, give you control of the entire broadcast program. Its operation is practically automatic—simply slide the pointer to the station you want and adjust the volume control, soft or loud as you like it.


Loud Speaker and "B" Batteries self enclosed in a beautiful cabinet that is far from mechanical in design and is an ideal mahogany furniture piece for the most charming home.

This new Ultradyne Model L-3 gives you the best there is in radio—truer reproduction than you have ever known before.

PHENIX RADIO CORPORATION 114-A East 25th Street
New York

Ask your dealer for a demonstration. The contrast between the Ultradyne and other receivers is so marked that the desire to own one will be bred there and then.

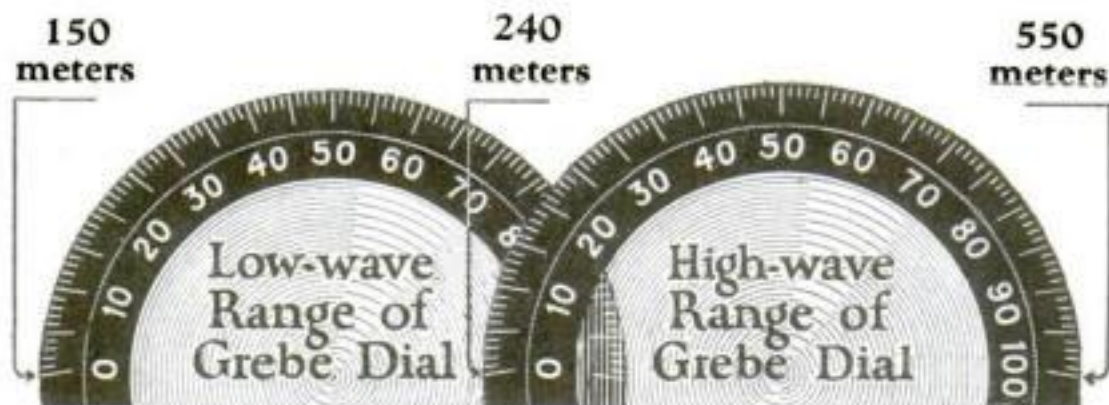
\$135

Write for
descriptive folder 





Grebe
Binocular
Coils



The Synchrophase Now Reaches from 550 Down to 150 Meters

THE Synchrophase, with the new Low-wave Extension Circuits, will receive all present and projected stations. It is really two receivers in one.

This great range is accomplished by means of an *auto-matic* switch which enables *one* dial to cover *two* wave ranges. The first, from 550 meters down to 240, corresponds to the practical tuning range of the usual receiver. The second overlaps this and goes down to 150 meters. Simply move the center dial past the 100 mark for the high range, and beyond the zero mark for the low range.

This low-wave reception opens up over 100 existing stations, broadcasting on less than 240 meters, and not reached by other sets. This will be especially valuable later, when stations generally begin to use lower wave lengths. The Synchrophase is thus equipped for the future.

Ask your dealer to demonstrate this new feature; then compare.

A. H. Grebe & Co., Inc., Steinway Hall, 109 West 57th Street, N. Y. C.
Factory: Van Wyck Blvd., Richmond Hill, New York
Western Branch: 443 S. San Pedro St., Los Angeles, Cal.

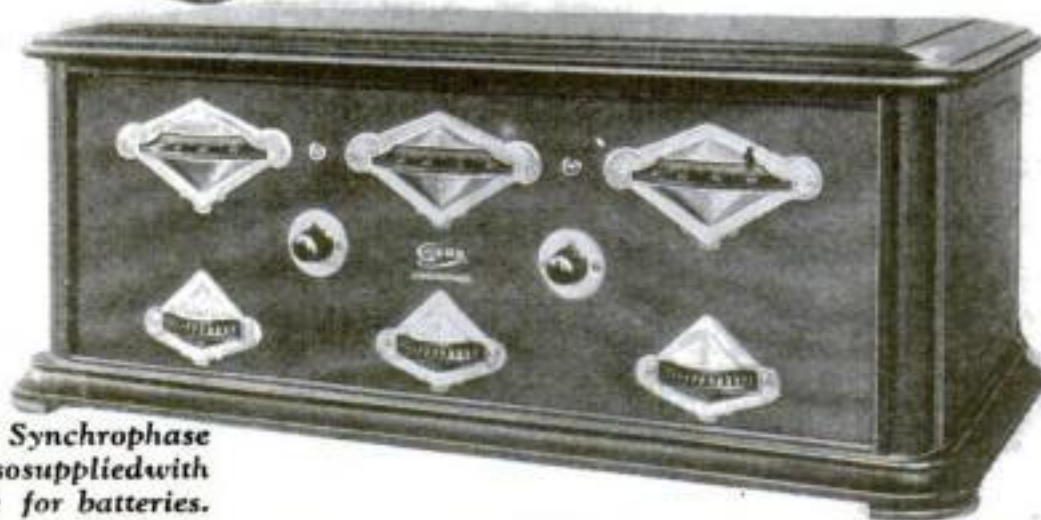
The
GREBE
SYNCHROPHASE
TRADE MARK REG. U.S. PAT. OFF.

This Company owns and operates stations WAHQ and WBOQ; also low-wave rebroadcasting stations, mobile WGMU, and marine WRMU.



It is written
"Where there is
much merit there
is great reward."
The merit of the
Synchrophase
has long been
proven.

Doctor H. H. H.



The Synchrophase
is also supplied with
base for batteries.



All Grebe apparatus is covered by patents granted and pending.

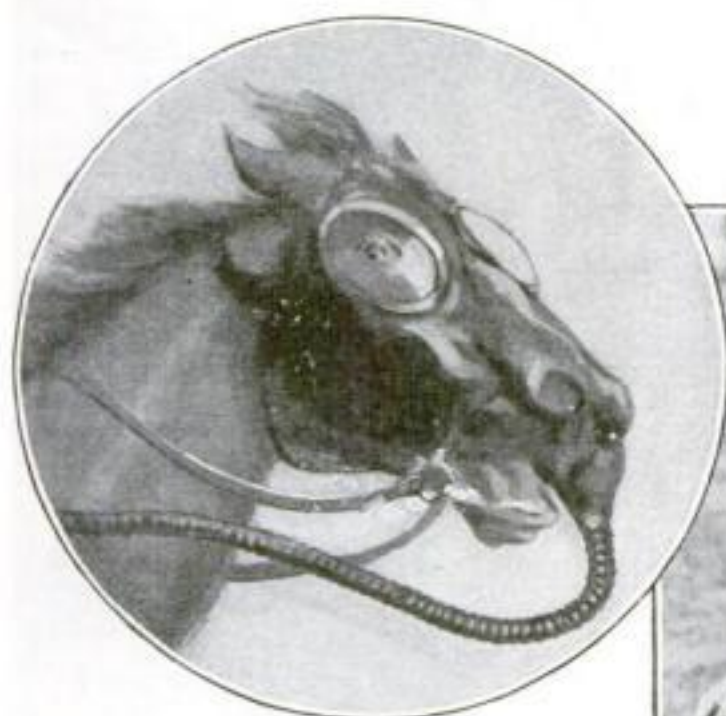


Gas Masks *for* War Horses

Strange Hoods Devised to Save Chargers, Dogs, and Pigeons from Deadly Fumes

By Capt. Adrian St. John

Corps Area Chemical Officer,
United States Army



Masked Steed of the Future?

New gases affecting the eyes of horses may at any moment necessitate the use of hooded, goggle-equipped masks, according to experts. The device shown here is equipped with a tube connected with a tank of counteracting chemicals on the horse's back.

A SKY dark with airplanes, each carrying a quarter of a ton of death-dealing gas! Huge cities laid waste and armies rendered impotent! This frightful picture of future war has taxed the ingenuity of the Chemical Warfare Division of the United States Army in the production of protective devices.

Amazingly effective gas masks have been developed for human beings. And now efforts are being turned toward masks for animals—horses, dogs, and pigeons—all valuable aids in warfare.

As far as horses are concerned, Nature has helped us in a very peculiar fashion. She has made horses' eyes insensitive to all of the ordinary forms of war gas. And, in addition, Nature has provided that horses shall not breathe through their mouths.

Thus, all we needed to do was to design a mask that would cover the horse's nostrils in such a way that the animal would be compelled to breathe through, and one of sufficient filtering surface to allow the animal to breathe easily.

The problem has been solved so well



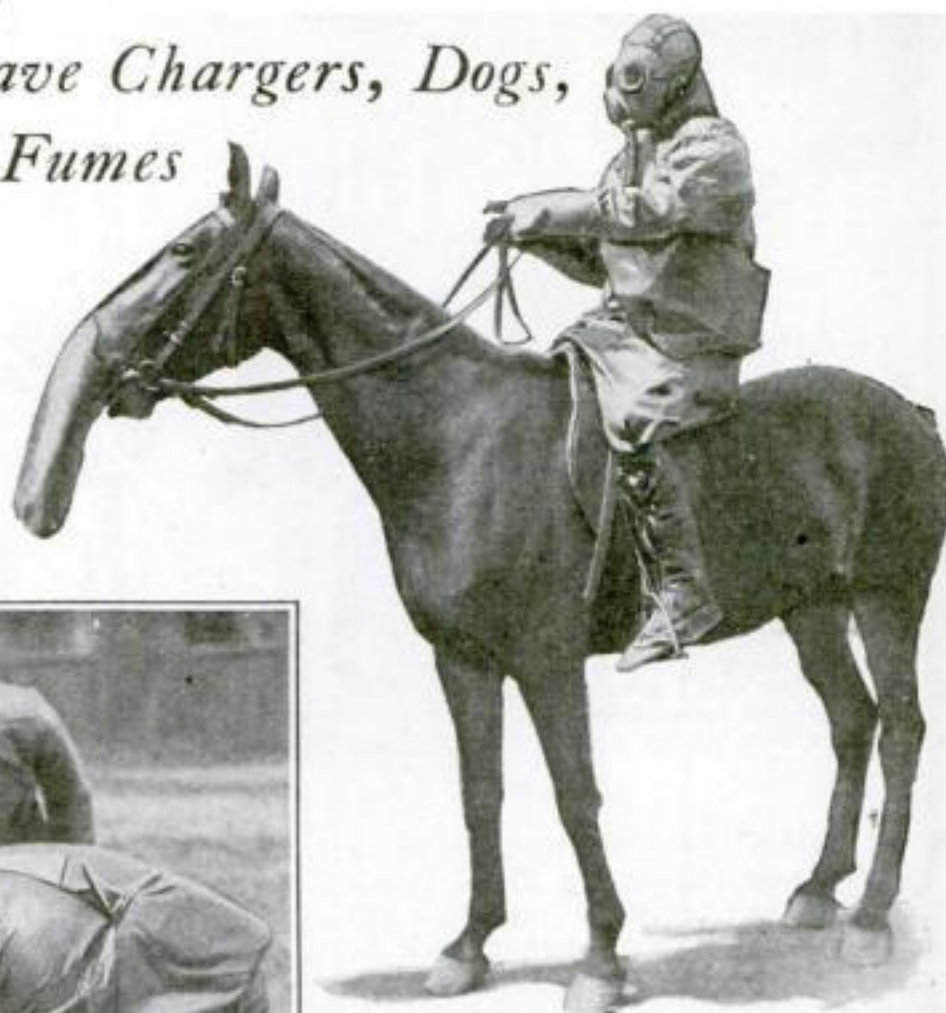
Like an Overgrown Mouse

Because the dog breathes through his mouth and his eyes and ears are sensitive to gas, his queer mask covers the entire head, making the animal look like an overgrown mouse.

that, in a recent test at Governor's Island, a horse carrying a rider went through a thick cloud of gas without suffering the least harm. The gas mask worn by the soldier was of the standard type, while the horse was fitted with a mask that resembles a huge feedbag, made of specially prepared cloth, impregnated with the special compound that absorbs the gas.

Curiously enough, horses' hoofs must be protected against the effects of gas—a problem that has been solved by the use of leather, cloth-lined boots that are laced on tightly.

Dogs presented problems more nearly



Used in Recent Tests

This long nosebag impregnated with chemicals is the latest type gas mask for horses. However, it affords no protection against possible development of a gas powerful enough to affect the horse's eyes.

parallel to those encountered with human beings. Their eyes and ears are sensitive to gas. They breathe through their mouths even more than do humans. These considerations made it imperative that the mask designed for canine use should cover the entire head of the animal, as shown in the center illustration.

Carrier pigeons do not wear individual masks. That method of providing for them proved utterly impractical in actual warfare. Pigeons always are carried in crates until released. The mask for pigeons, therefore, consists simply of a cloth bag with a drawstring. The bag is slipped over the crate and the drawstring pulled up tightly. The cloth of the bag is sufficiently porous to admit plenty of air, yet it absorbs the gas.

WHEN it comes time to release a pigeon, the bird is withdrawn as quickly as possible and thrown high in the air. Spiraling straight up, the winged messenger is above the gas cloud before any damage is done.

Investigation and experimental work still are going on. It is possible that some future development may make masks fitted with goggles, or a complete covering for the horse's body an absolute necessity.

Inventive Genius on

How Scientific Devices and Clever Tricks of Training Add to Thrills of Football

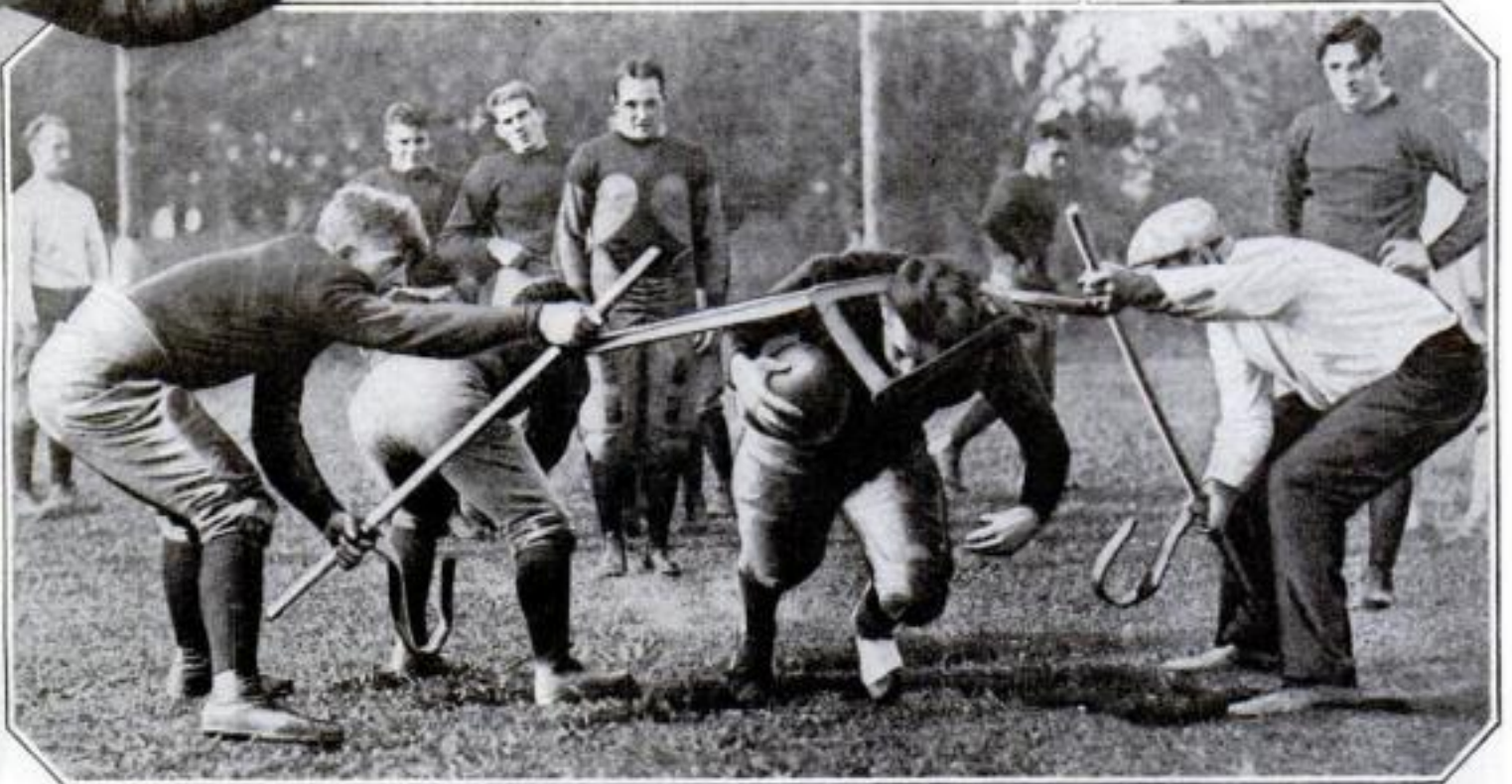


Latest in Headgear

Replacing the long, shaggy locks of old-time football warriors, this new style headgear protects nose, cheeks, jaw, and the skull

Bucking Harness

To aid backfield men to develop driving power, Larry Bankart, former Dartmouth star, devised the ingenious collar shown at right, held by two men



WHILE Sol Metzger, once a famous star on the Pennsylvania football team, was coaching the West Virginia eleven some years back, he reported for work one fall to find a squad composed largely of inexperienced men. They were agile, strong, robust, and full of the desire to play football, but they were lacking, in many instances, even the rudiments of the gridiron game, especially tackling.

Metzger worked patiently, trying to teach them the knack of hitting their men low. But the trick of diving at an opposing runner and nipping him just above the shoe laces comes naturally to but few. The tendency is to go in high, grabbing out at the runner like a drowning man clutching at a straw. This leaves the would-be tackler an easy mark for a good stiff-arm jab by the runner.

Metzger labored persistently, but to little avail, and the situation was growing desperate when one night after practice, he thought of a scheme. When the men went out for practice the next afternoon, they found stretched in front of the row of tackling dummies, at a height of some three feet, a thick, wide board that bore in large black letters the legend, "TACKLE LOW."

The first order of practice that day was a long session at hitting the dummies, in which the men naturally had to plunge under that board. The result was startling. Before the end of the season, Metzger's rookies had developed into a band of savage tacklers.

Football is rich in similar experiences, wherein necessity has mothered invention. The human machines that thrill bleacher crowds today are products of training tricks and devices that are a

direct application of science and invention. This fall more of these are to be used than ever before.

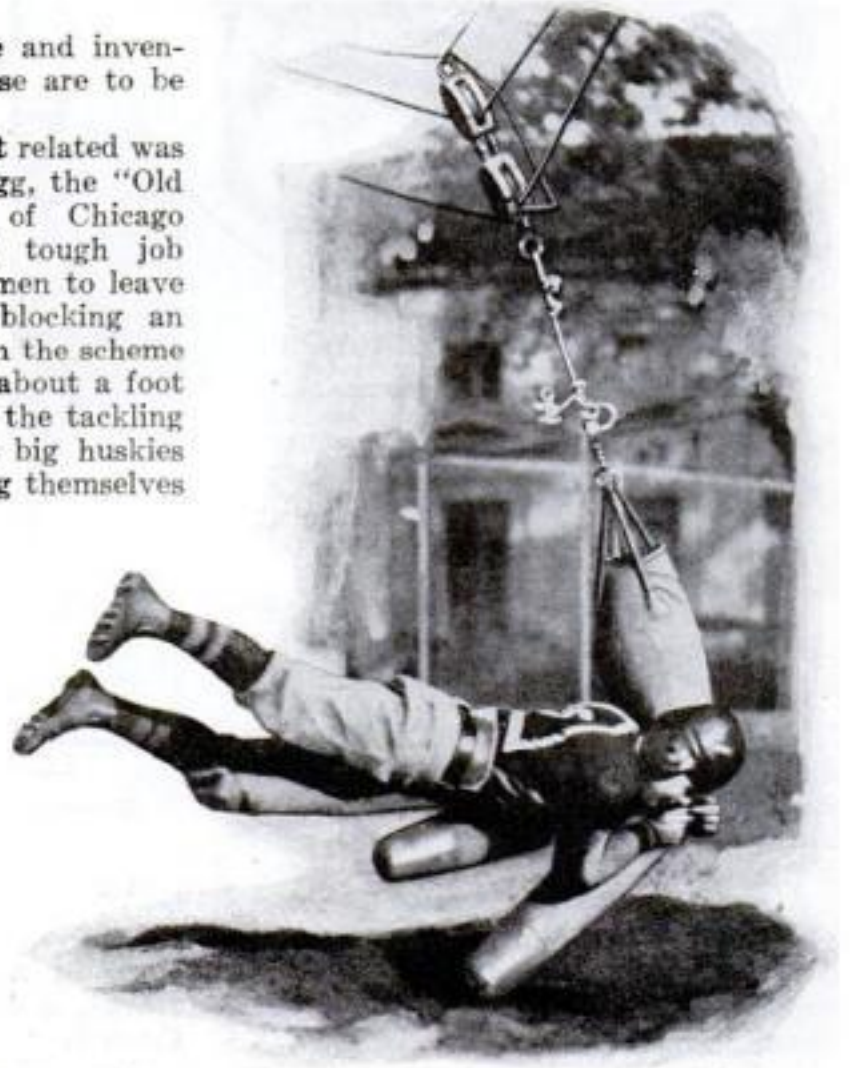
A stunt similar to that just related was conceived by Alonzo A. Stagg, the "Old Man" of the University of Chicago eleven. Stagg found it a tough job teaching his big, heavy linemen to leave their feet in tackling or blocking an opponent. Finally, he hit on the scheme of stretching a two-by-four about a foot from the ground in front of the tackling dummies, and having these big huskies clear that board in launching themselves at the dummies. They left their feet all right—they had to, or else trip over the board.

ANOTHER scheme of Stagg's was the introduction of the Ghost Ball, which was to become famous throughout the country. Each fall, Stagg found that not nearly enough daylight was available for drilling his charges. As soon as dusk began to fall, it became next to impossible to fol-

low the ball in passing. Then he hit on the idea of having a dozen or so balls painted with a luminous white paint. This solved the problem.

Gil Dobie took another tack to meet similar conditions at Cornell. He had the field strung with high power electric lights.

To Glenn "Pop" Warner, coach of the Stanford University eleven, and former mentor at the University of Georgia, Cornell, the Carlisle Indian School, and



Downed with a Flying Tackle

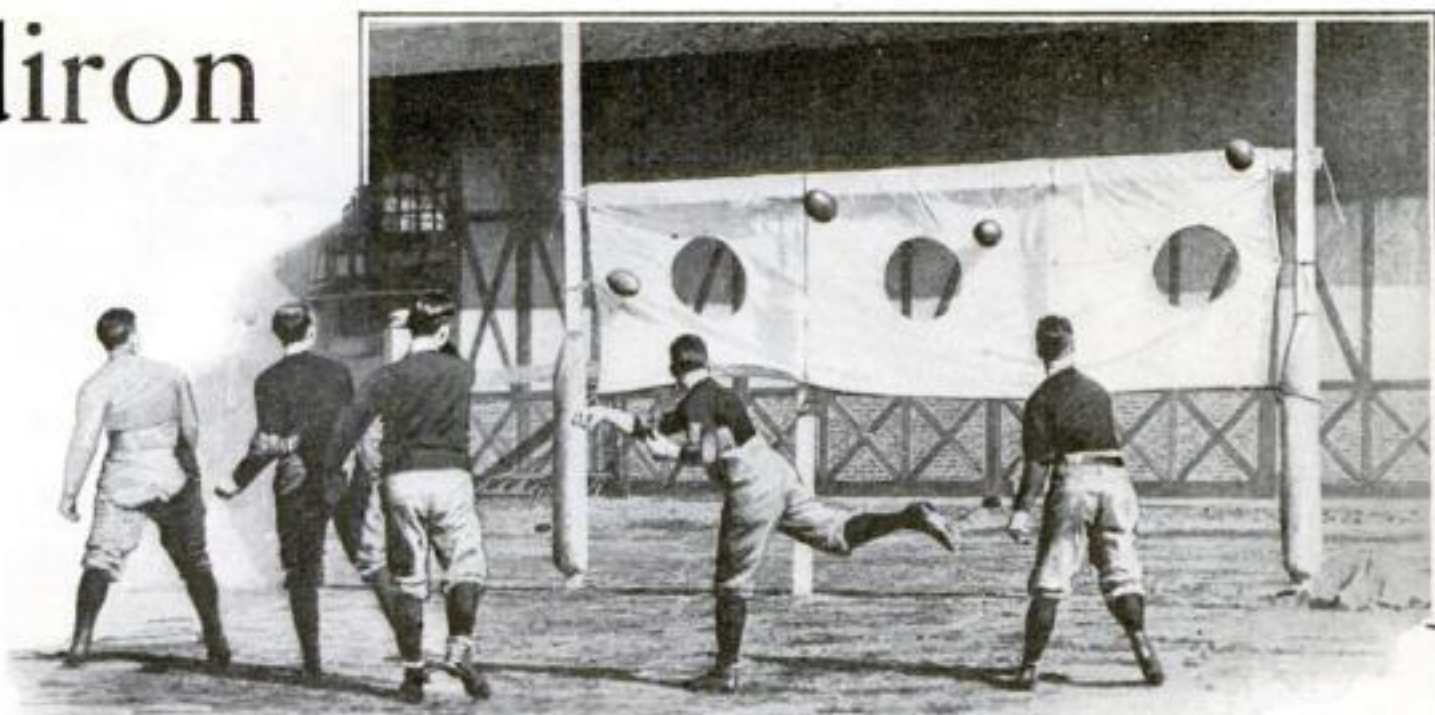
Practically every big college team practises with tackling dummies such as this—a stuffed canvas "man" suspended from a trolley in such a way that it goes down to the ground with the tackler

the University of Pittsburgh, goes the distinction of having introduced possibly more new training tricks and devices than any other man. One of the most important of these is the charging machine,

the Gridiron

By
INNIS BROWN

Mr. Brown is a well-known football critic and writer. In addition, thousands of radio fans are acquainted with him through his broadcast reports of big Eastern games. His expert knowledge of the gridiron is based on three years' experience as a player on the Vanderbilt College team, which he captained for one year, and also five years as a football referee.



Stars of the Forward Pass at the Target Range

Development of the open style of play and the use of the forward pass led to the invention of this ingenious "shooting" gallery at Harvard, to develop accuracy in passing. Each player tries to shoot the ball through one of the three 18-inch holes to improve his throwing ability.

a contrivance now used quite generally.

This device is a heavily built platform, roughly five feet wide and 10 feet long, mounted on small wheels. Along one side, at a height of about 30 inches, runs a wide padded board. The method of use is to load half a dozen men or more on the platform to provide ballast, and then line up from four to six others in a crouching position about the distance from the machine that would separate them from an opposing line. The latter charge against the machine and push it back. Concerted action is necessary to move the device, and unless all charge together, somebody is due for a painful shock. The main idea was to develop driving power in the legs, but the machine also serves to train men in starting together. Very similar in operation is the "bucking machine" used by Coach Bob Folwell in training the Navy gridiron stars. The machine, a large boxlike structure, has heavily padded supports, against which the players charge.

LARRY BANKART, former Dartmouth star and later coach at Colgate, devised a departure from the charging machine, which can be used to help backfield men in acquiring driving power, and at the same time allow them to carry the ball. Bankart's creation, a bucking harness, consists of a leather

collar some 15 inches in diameter, to which four leather straps are attached. These straps are fastened to two wooden staffs, which are held vertically by two huskies, while the back carrying the ball rams his way forward, thrusting his head through the collar and catapulting himself forward as far as possible.

The tackling dummy is part of the equipment of practically every college team, and is one of the most useful of training aids. This dummy is a stuffed canvas "man." It is suspended from a trolley wire by an arrangement by which the tackler's weight detaches it from its moorings, so that player and dummy go down together as in an actual tackle.

One thing about such dummies seemed wrong to Walter T. Stall, a football enthusiast of Brockton, Mass.—the dummy remained stationary while the tacklers approached. To simulate real conditions, the dummy should be running, too. With a new device, patented

recently, Mr. Stall has remedied this.

His contribution is a portable tackling dummy with leather handles at the top, so that it can be carried by two players, one on each side. These run down the field with the dummy swinging between them, in position to be tackled by a player running from the opposite direction as in the actual game.

In the 50-odd years of football development, there have been many interesting changes both in the game itself and in the matter of equipment and appliances. In the early days an outstanding feature of the player's protective equipment was a thick mop of long, shaggy hair. This abundant capillary adornment, a pair of quilted, padded, knee-length canvas pants, and a sweater of sorts, about completed the player's trappings.

But the tousled hair had its disadvantages. It was too likely to engage the outstretched hand of an opposing tackler. Then some one thought of a leather skull cap, and the headgear of leather came into existence.

IT WAS a rough old game in those days, and bloody noses were a common sight, until John Morrill, famous years ago as a professional baseball player, conceived the idea of a nose protector.

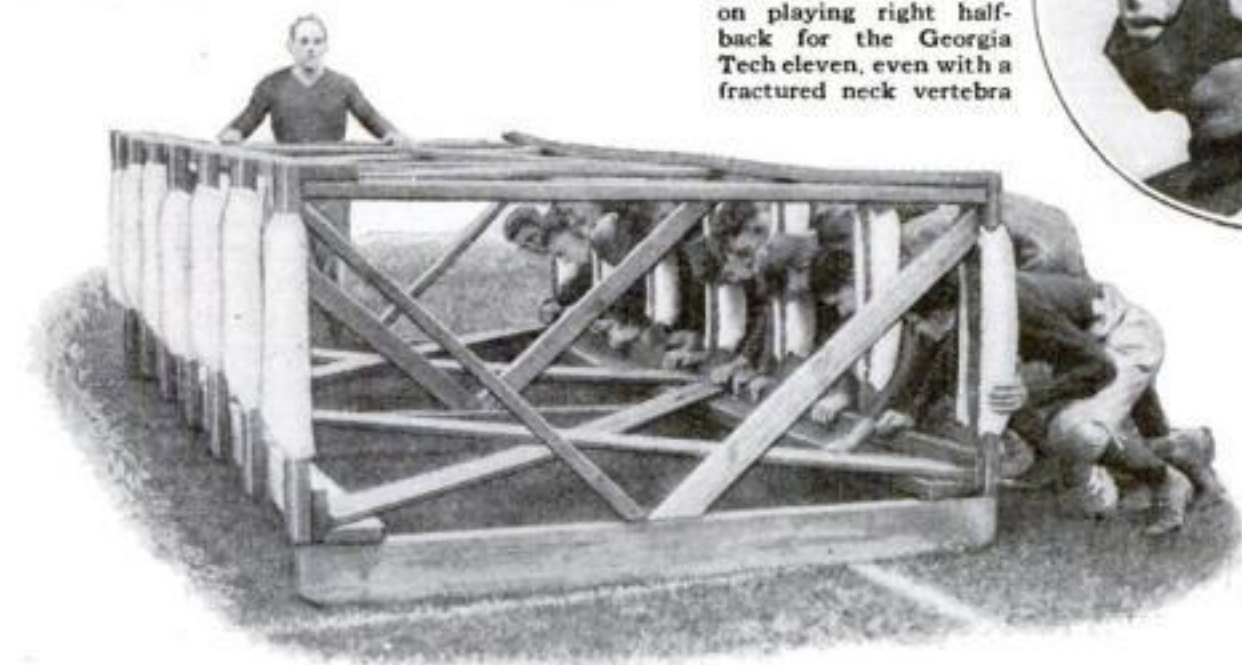
He fashioned an appliance of hard rubber that fits over the nose, resting against the forehead, and having a rubber grip to be held between the teeth for keeping it in place. This was the first nose guard. Also came shin guards.

Twenty years ago, just before the first beginning of the game, the football player in full regalia was an imposing and picturesque individual. In addition to the trappings already mentioned, he wore thickly padded moleskin pants—sometimes a union suit—elbow pads, shoulder pads—a pair of cupped leather pockets

(Continued on page 158)

He Played with a Broken Neck

This scientifically designed brace enabled Ivan Williams to keep on playing right half-back for the Georgia Tech eleven, even with a fractured neck vertebra



This Machine Develops Hard-Charging Linemen

Navy huskies are seen here practising with the "bucking machine" used by Coach Bob Folwell, to develop concerted action. To move the machine all players must charge at once

Who Will Win?

Sorting a pile of entries in the \$10,000 Prize Contest



Our Great \$10,000 WHAT'S WRONG Contest!

JUST 20 days from the publication date of this issue, and POPULAR SCIENCE MONTHLY'S sensational \$10,000 "What's Wanted" Contest will be over—at least so far as the receiving of entries is concerned. You have until September 30 to submit your solutions in the final monthly contest—which appeared in the September issue—and for the Grand Prize Contest.

Many of those who have submitted solutions for each set of eight pictures as they appeared, competing for the monthly prizes, now are submitting complete new sets of the entire 32 pictures, as a final effort to win Grand Prizes. This is not necessary, since all solutions submitted monthly by any individual are held and four sets judged as a unit in the Grand Prize Contest.

If, however, you have changed your mind as to the correctness of your original solutions, you may submit, in the Grand Prize competition, as many additional sets as you like, provided they reach the office of POPULAR SCIENCE MONTHLY not later than September 30.

For the past four months a dozen competent and experienced persons have been kept busy sorting entries and giving them the first reading. Each entry has received equal consideration. Those written in pencil on scraps of writing-paper have been handled just as carefully as those more ingeniously and elaborately prepared.

Some of these latter reveal remarkable originality and no little labor. Yet accuracy is the first consideration of the judges, and in awarding prizes, accuracy and clearness will outweigh skill of presentation. Of course, all other things being equal, the most

skillfully presented solutions will win.

Manuscripts have been received at the rate of many hundreds a day, the entries in the aggregate running well up into the thousands. Unfortunately, a large number of entrants forgot to write their names and addresses on their solutions, as stipulated in the rules. These, of course, the judges must disregard.

Contestants live in almost every country in the world. A Hindu from the interior of India cabled in vain for an extension of the time limit, since his copy of the magazine reaches him three months after publication. A missionary in Central Africa made a similar plea. A veteran of the A. E. F., living in a little Normandy village, wrote of the interest of his neighbors in the contest. The South Seas and the Arctic Circle join with every state in the Union in contributing entrants.

MANY of the letters accompanying solutions assured the judges that the writers were certain to win one or more prizes. Several persons sent their

photographs with instructions to use them in connection with the announcement of the awards. One reader asked that the judges send his prize money to an address other than that of his home, that his wife might not take it away from him. Another said he was so sure of winning that he had begun negotiations for a home to be purchased with his prize money from the contest.

OF COURSE, even with as many as 580 cash prizes to be awarded, some of the contestants who have worked hard and enthusiastically are bound to be disappointed. Yet every one of the thousands of persons who entered will agree, we believe, that whether they win or not, the contest has been most fascinating and profitable. It has sharpened our wits, stimulated our powers of observation, increased our knowledge of every-day mechanical things, and given us many evenings of worth-while enjoyment.

Of the mistakes that John and Mary have made, some have been simple, others more difficult to find. But each one has held some useful suggestion.

The editors of POPULAR SCIENCE MONTHLY are awaiting the announcement of the first awards in the contest no less eagerly than our readers. And the judges, who are doing their job thoroughly, promise to have the winners of the June contest ready for publication in our November issue, published October 10.

The three judges for the contests—Prof. Collins P. Bliss, Dr. Hazen G. Tyler, and Alexander Senauke, M.E., E.E.—all are members of the staff of the Popular Science Institute of Standards and their decisions will be final.

Watch for Winners' Names

NAMES of the prize-winners in the first of the four monthly "What's Wrong" Contests, which appeared in the June issue, will be published in our November number—on the newsstands October 10. Winners in the July, August, and September contests will be announced in the December, January, and February issues respectively. The Grand Prize winners will be announced as soon as possible after entries close.

A Romance of the Microscope

The Amazing Story of How Fate, Three Men, and a Hobby Discovered the Cancer Germ

By Peter Vischer

THE old man was getting along in years. And he hadn't done anything yet. All his life long he had wanted to do something, something that would live through time, something great, monumental, something that would make the name of Gye send forth such a beacon of shining light that even unthinking, careless, hurrying men would remember, halt, and pay homage. There weren't many years left, he knew that, and it began to look as though his ambition were doomed to go to the grave with him.

He had money, old man Gye had, but not much. He didn't have enough to found a school, or build a hospital, or leave some other legacy worthy to bear his name through the ages. No, he couldn't do that. And he had no children to turn to, none to carry on in his name.

Gye frequently bemoaned his fate, his thwarted ambition, as he hurried from the heart of London and through the railway station at Derbyshire, to his home. So it was on this day, when, as happened every morning and every night, he was accosted with a cheery good day.

"**A**H, GOOD day, Bullock," he replied, stopping to chat with the station-master, a young chap, earnest and serious, who also knew the pangs and pains of ambition. Bullock wanted to be a scientist, but he was poor, and he had to earn his living at railroading, help support an invalid mother, and use only what he denied himself for the only treasure life seemed to hold for him—books. Between trains this youth studied.

They often talked of their ambitions, Gye and Bullock—the old man from whom life was ebbing fast, and the young man whose blood was only beginning to boil. And this they did again for some moments, until the older man, his face lighted with sudden inspiration, grasped the younger by the arm and gripped it tight with excitement.

"I am not famous, nor will I be," he said hoarsely. "I have no children. I believe in you. I have faith in you. Some day you will be famous. I can see that. I will leave you the money I have so that you can pursue your life's ambition, if you will agree to take the name of Gye."

And so it happened. One day, not very much later, while Bullock was still down at the station dividing his time between his duties and



J. E. Barnard, London hatter, whose experiments with microscopes helped isolate the cancer germ, a problem that had baffled the wisest scientists for at least 6000 years

The Hatter Who Rode a Hobby to Fame

his books, the old man died. And the invalid mother died of cancer. Young Bill Bullock resigned his job and, taking the name of his patron, as William Ewart Gye set his face toward his future.

Before long, Gye (the erstwhile Bul-



The Boy Whose Dream Came True

Dr. William E. Gye, who started life as William Bullock, ambitious railway porter. He got his chance by taking an old man's name. Now he has made it famous by isolating the long sought cancer germ

lock) found the path he was seeking and, as a promising student of medicine was enrolled at Edinburgh University. There he sat under the brilliant Bennett, an expert on cancer, the dread scourge of humanity, which for 6000 known years had defied investigation. Gye began to study this unrelenting disease that had sent his mother to an agonizing death.

GYE worked hard and long. For a time his labors were interrupted, for war came and every true Briton did his bit. He was attached to an ambulance train and made studies of gas gangrene that were of inestimable scientific value. But this was only an interlude. No sooner was the war over than Gye went back to his cancer studies.

Incessantly he worked. For two years he did not rest from his researches except to sleep and eat. Christmas Day saw him hard at work in his laboratory. He made thousands of experiments with one aim, the isolation of the cancer virus. Many times when success seemed only a step ahead, he was compelled to begin all over again.

Finally he came up against a stone wall. He was satisfied that cancer is caused by a germ that enters the body from without, but he was unable to isolate the germ.

He tried filtration, but the germs were so small they could not be taken out of a liquid by the finest filter. He tried catching them under a microscope,

Brings Hope to Thousands

CANCER, spreading rapidly, has been threatening recently to take first place in the list of diseases that kill human beings. Nearly 100,000 persons died of it in the United States last year. It is a horrible scourge, killing with slow torture, practically hopeless when beyond the reach of surgery.

And now, with the isolation of the cancer germ, comes hope that this fearful, mysterious enemy of mankind may be conquered at last. Mr. Vischer's story of this tremendous scientific achievement, as told here, reads like a page from an Arabian Night's tale.

but the finest microscope he had ever heard of—instruments that magnified 1500 times—would not reveal them.

Gye was stumped.

Now, as so often happens in life, chance enters. The long arm of coincidence, so much longer in real life than any fictionist would dare make it, begins to reach out. It happened that a hatter in Jermyn Street, one J. E. Barnard, head of the firm of William Barnard & Sons, Hatters, had a hobby. By all the rote of successful business life and the usual aspirations of a shopkeeper, he was as mad a hatter as the hatter Alice met in Wonderland. Instead of hurrying to a golf course when the day's work was done, or to a card club, or to the races—which anybody could have told him was the proper thing for a hatter with an income to do—he went home and amused himself with microscopes.

AFTER a while Barnard, the hatter, became known among British scientists as a willing amateur who knew more than a little about lenses. Then Barnard, the hatter, came to be known among British scientists as the man who knew more about lenses than any one in the British Isles. The British Medical Research Council started its great cancer research at Hampstead and nearly every day Barnard, the hatter, after his new stock of bowlers had been arranged and the day's receipts had been counted up, hied himself to the Hampstead laboratories to experiment with new lights for microscopy that might impress on a photographic plate things invisible to the eye.

By ordinary light rays, about 550 millionths of a millimeter in length, magnification 1500 times is possible. But Barnard knew that by shorter light rays, by ultra-violet rays only 275 millionths long, he would be able to magnify 3000 times, even though he wouldn't be able to see the result. So he experimented with the invention of a group of German scientists at Jena, first announced in 1904, by which lenses of pure quartz were used instead of glass. The ultra-violet light was provided by an electric spark's jumping between two little points of cadmium. And photographic plates were used to catch the invisible light coming up through the lenses with the picture.

IT WAS inevitable that Gye, the one-time railway porter with an ambition, should some day meet Barnard, the hatter with a hobby. When Gye confided to friends that he could go no further with his researches unless he could find a more powerful microscope, it was only a matter of time until some one would say to him that he would have to meet Barnard.

The two met.

"I've got to catch these viruses under a microscope if my experiments are to succeed," said Gye to Barnard. "Can you do it for me?"

"I'll try," said Barnard.

The two worked together steadily and patiently. Gye was constantly at it. Barnard hurried over from Jermyn Street just as soon as his business would free him. Together they conducted countless experiments. They hoped in time to get a picture of 50,000 or perhaps even 100,000 of the cancer germs in a group. That would have been an unprecedented achievement, for it would have made

theory into fact and would have provided a foundation from which to fight and eventually defeat one of the three worst of earth's scourges.

They worked quietly and unostentatiously. Time and again cures for cancer have been announced and time and again the hearts of men and women have been buoyed up with hope, then cruelly twisted, because the report of a cure was false. Gye and Barnard wanted to make no such mistake. Furthermore, they knew that with the isolation of the virus the battle would be only half won. A cure must be found later.

So they kept at it. And finally, one



Cancer Tests with Chicks

Doctor Gye inoculating a young chick with the cancer virus. His experiments showed that the cancer germ produced a malignant growth only when introduced into the victim with germ-free extracts of tumors

day, Barnard, with quivering hand, turned over to Gye a microphotograph. Gye took it and held it to the light. There was something never before seen by man, something that no eye could ever see, even with the most powerful microscopes—a photograph of a single round organism enticed into visibility by rays of light too thin for sight to catch. Not 50,000 in a conglomerate mass, mind you, but a single round cell—a cancer germ!

"I think we've got it this time," said Gye to Barnard.

And the two hurried on with their work.

SOME weeks later a crowd gathered in a street outside the office of the *Lancet*, an English medical journal. At first it was just such an indescribable gathering as happens hundreds of times a day, for no particular reason, in New York, or Chicago, or San Francisco. But this crowd swelled minute by minute, until it bulged through the Strand and disrupted the normal traffic of the street. It was not a joyous crowd, nor yet an angry one, nor yet one merely inquisitive. It was quiet and patient, throbbing with a deep excitement.

The event that drew the great crowd

was an announcement by the *Lancet* that the germ of cancer had been isolated by Dr. W. E. Gye, once a railway porter, and J. E. Barnard, a prosperous hatter. While the announcement made it plain that the discovery was in no way a cure for cancer, yet it was hailed instantly by scientists throughout the world as one of the greatest medical achievements in history.

FOR in tracing the cause of cancer to a germ, the discoverers laid bare a mystery that has baffled physicians for generations. By providing definite knowledge, they paved the way for direct attack on this most dreaded scourge. And they gave science effective new weapons for striking at the root of other diseases.

Scientists point out that, as with other diseases, the discovery of the cause is just the beginning in the fight to wipe out cancer. How soon it can be conquered, no one can say. In the case of malaria, for example, the enemy went down easily, once it had been located.

Research workers gradually discovered that malaria was caused by a germ introduced into the blood by a certain type of mosquito. They knew, therefore, that if the mosquito could be prevented from biting men, malaria could be prevented. Other scientists took up the fight, attacking the mosquito in its breeding-grounds and making malarial districts healthy.

In the case of diabetes the fight was more stubborn, yet a cure was found at last in the discovery of insulin. But in the war against tuberculosis, although the position of the enemy long has been known, and although its death toll has been greatly lessened, today there is no known cure other than that of strengthening the body to resist the germs' attack.

In discovering the cancer germ Gye and Barnard reconciled two hitherto conflicting theories of cancer. One theory, commonly held by authorities, was that the disease was due to some change in the body by which unhealthy cells at a bruised point were converted into malignant cells. The other was that cancer was due to a germ entering the body from without.

In experiments with chickens, rats, and mice, Doctor Gye found that both theories were right—that cancer is caused by a germ, but that the germ is able to grow only in unhealthy cells.

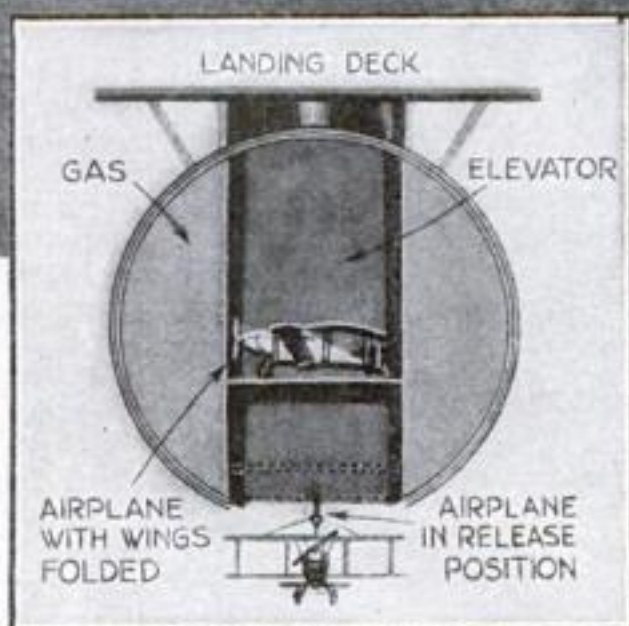
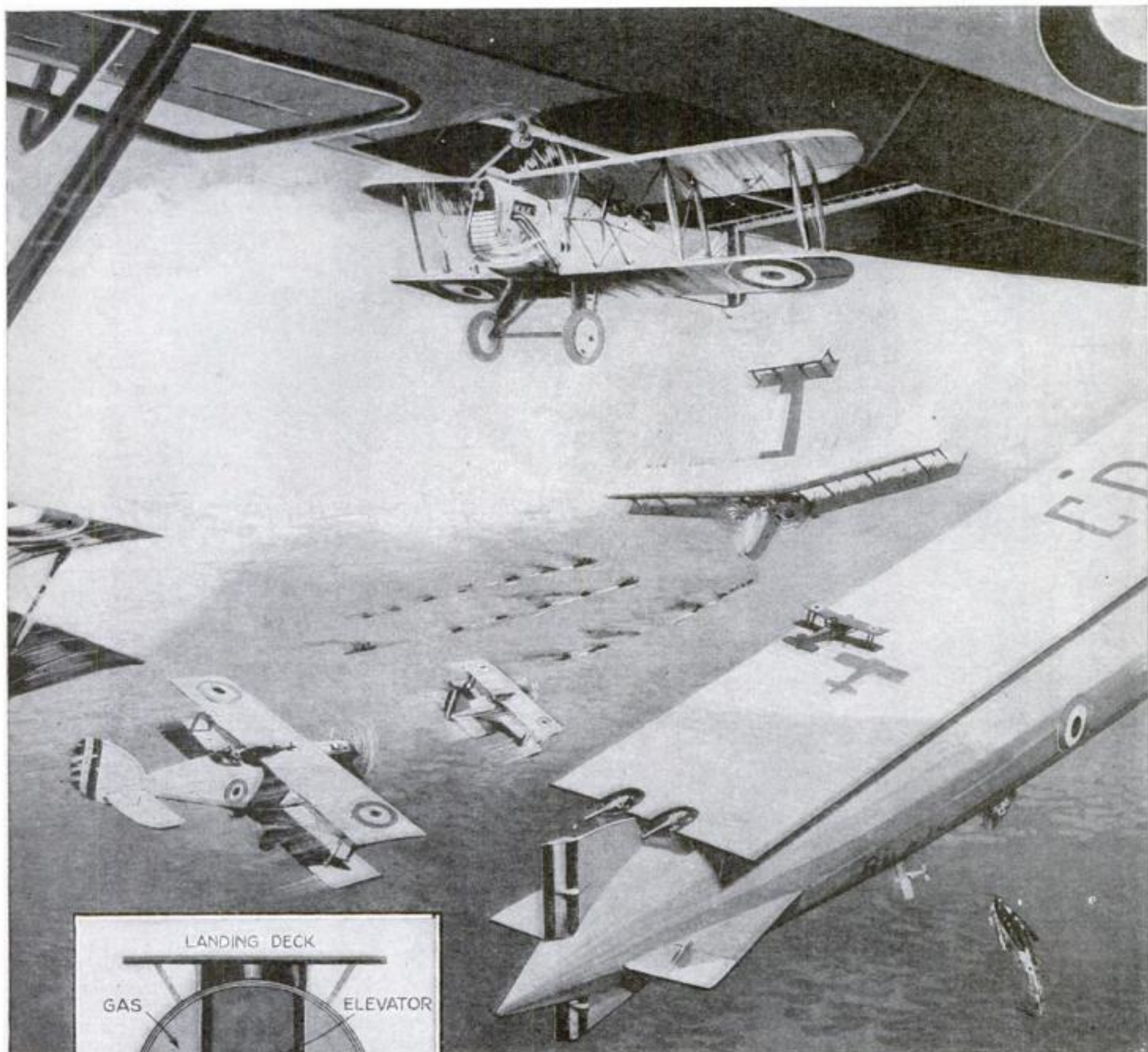
THIS fact Doctor Gye demonstrated by inoculation of mice. Introduced by itself, the cancer germ was powerless, he found. Only by introducing both the germ and germ-free extracts of tumors was he able to grow cancers in mice.

With the cancer germ isolated, Doctor Gye and his colleagues in the British Medical Research Council now are busy with experiments to develop a cancer vaccine that will make it impossible for the germ to secure a foothold in the body. In the Hampstead laboratories, definite success has been reported in making chickens, rats, and mice immune to the disease by inoculating them with a serum made from the newly discovered virus.

The perfection of human inoculation against cancer, of course, will not be a cure for the disease already contracted, yet scientists hold out the hope that soon it may furnish the basis for a preventive campaign to eradicate this curse of man from the face of the earth.

A Giant Mother of Airplanes

Dirigible to Act as a Hangar for Fleet of Smaller Craft



ONE of the most daring ideas in aeronautics recently was proposed in England. It is that a dirigible shall be built—a dirigible far larger than our own *Shenandoah*—to carry a small fleet of airplanes. As shown in the diagram below, at least three-fourths of the great ship is to be used for hangars.

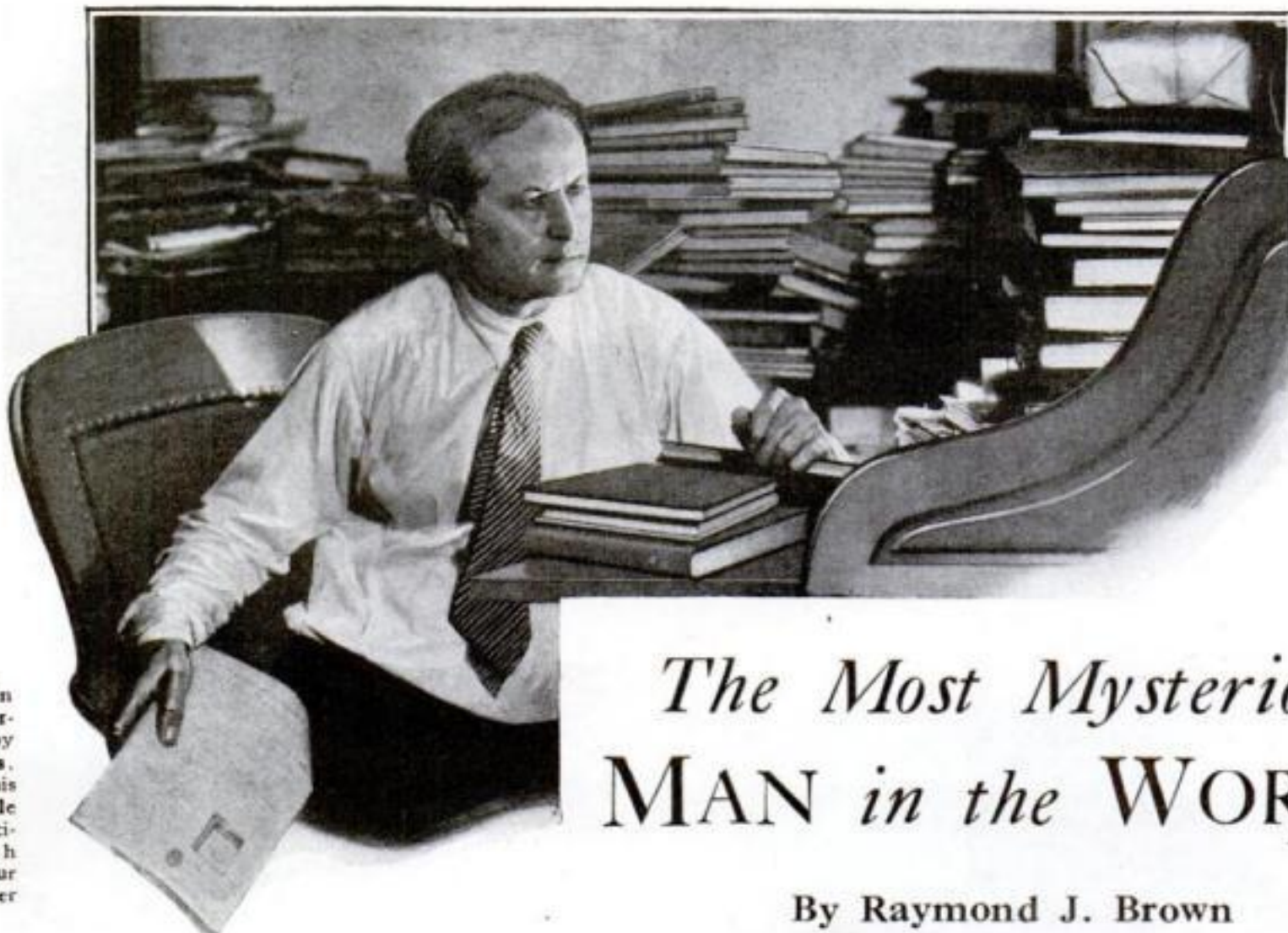
The executive officer of the dirigible receives a radio message, asking for a

plane to call at some outlying post or town. A plane is wheeled out into the central runway until it reaches the release chamber, and with a slight pause for adjustment of engine and wings, she hops off. Returning, the plane lands on the broad, flat top deck of the dirigible, is received by the elevator and restored to the hangar deck, where it is entirely overhauled.



Cut-away view, showing interior of the giant dirigible that will carry small airplanes for scouting or mail service

HOUDINI —



Houdini in his study, surrounded by his books, preparing his remarkable series of articles which begins in our next number

The Most Mysterious **MAN in the WORLD**

By Raymond J. Brown

I HAD seen Houdini on the stage—many times. I saw him first 20 years or more ago, when he was known as the "Handcuff King," and was exhibiting his astonishing ability to escape from shackles, ropes, chains, strait-jackets, locked trunks, and a variety of other bonds and entanglements.

I had seen him in more recent years cause a five-ton elephant to disappear from the stage. I had seen him shackled and thrust head first into a metal cylinder filled with water, over which a tight-fitting cover was padlocked. There seemed no possible escape for him from this dreadful contrivance; yet, only a second, it seemed, after the big can was screened by a curtain, he emerged, dripping and breathless, the shackles in his hand and a smile on his face.

I had seen him perform his famous needle trick in which he swallows four or five packages of needles and many yards of thread, and then has a member of the audience pull all from his mouth—with every needle threaded! I had seen his amusing but highly instructive and useful exposure of the tricks of fraudulent spiritualistic mediums.

But my greatest surprise from this master conjurer was reserved for a few weeks ago when I visited Houdini at his home in New York City. I found Houdini the man a more extraordinary personage even than Houdini the magician!

Houdini the magician—the man known to the public—is a professional trickster, an expert showman; spectacular, theatrical, practised in every artifice and device of the public entertainer. Houdini the

man, though, is a student and scientist, who prefers his library, stocked with a quarter of a million dollars' worth of books, on every conceivable subject, to any other place on earth.

He is master of six languages, and is versed in the literature produced by the greatest thinkers in all six tongues. He has profound knowledge, both practical and theoretical, of the natural sciences. He handles mechanics' tools and the delicate apparatus of the physical and chemical laboratory with the deftness of a specialist. He is an author, a psychologist, an anatomist, an inventor, a brilliant talker, a world traveler.

He has known the greatest men of his time and in these contacts has contributed quite as much as he has taken away. He is an athlete, who by training and self-denial has kept to middle life the lithe, powerful body necessary to the performance of his amazing feats. He is a business man, whose shrewd investments have made him one of the wealthiest men of the theatrical world.

AND it is Houdini the man who dominates Houdini the magician. As Houdini himself expresses it, "I could make a fortune every year on the stage—if I wished to."

Houdini the man, however, will not permit this. For five months each year Houdini the magician appears before the public; the other seven months belong to Houdini the man. Then it is that Houdini immures himself in his library to read, study, write, and to invent.

It may seem surprising that one whose

chief fame has come from dexterity of hand and strength of body should possess so remarkable a passion for pursuits of the mind. Actually, though, there is nothing surprising about it; for Houdini was a scholar and a teacher long before he became a magician. The son of a clergyman and educator, he was reared in a scholastic atmosphere, and almost before he was out of knee pants, he taught modern and ancient languages in the school his father conducted in Wisconsin.

"Books were my hobby, even as a child," he told me. "I read almost every book in the Milwaukee Public Library before I was 15. My reading was not systematic. It made no difference to me whether they were fairy tales, textbooks, philosophic essays, poetry, or romantic fiction. Some of the books I didn't understand—but I read them just the same. I believed, you see, that my life work would be teaching, so I wanted to learn everything I could about every possible subject."

"It's rather strange, isn't it, that a book-lover should take up such an unusual profession as magic?" I suggested.

"I went into magic more or less suddenly and by accident," Houdini said. "When I was about 15 I was attending a magician's performance with some friends. I hadn't studied magic particularly at the time; yet I wasn't mystified at all. Each time the magician would complete a trick, I'd tell my friends, 'I know how he does that,' and at last they got tired of hearing me say it. 'Well, if you're so darned smart,' one of them said, 'why don't

you go on the stage and do those tricks yourself?" "All right," I said; "I will." And I did.

"That was more than 35 years ago," continued Houdini reminiscently, "and I've been at it ever since. I made up my mind at the beginning, though, that if I was going to be a magician, I was going to be a good one. There seemed only one way to make sure of that, and that was by devising my own tricks—tricks that no one had ever seen before.

"My habit of reading stood me in good stead. I bought every book on magic that I could find, taught myself to do every trick that was described—and then discarded them all and invented original tricks and constructed with my own hands the apparatus necessary to perform them. And I've been doing that ever since. Every illusion I ever have performed has been conceived, constructed, and executed by me alone. And not one of them," he added after a moment, "ever has been correctly explained. I have performed them before millions of people. I have performed them privately before professional magicians; and they are still secrets—mysteries—known to me alone.

"One of the greatest thrills I've ever had came when I was a young performer and it was reported to me that Kellar, dean of American magicians, was saying to his interested and puzzled audiences:

"Don't be ashamed if I mystify you. I have seen Houdini's work, and I have no idea how he produces his effects."

"Do you intend ever to explain how you produce your effects?" I ventured.

"Certainly," Houdini answered. "I'll explain to you right now. I produce my effects by natural, physical means; by utilizing well-known laws of science and mechanics for the purpose of mystifying. I have no occult powers. I can no more tell you what you are thinking about at this moment than I can cause those buildings opposite us to collapse by waving my hand.

"I cannot transfer my thoughts to another person's mind except through some recognized form of communication. I cannot bring back the spirit of one who has departed. If you were to lock me in this room, I could not escape except by means of a key, violence, or the employment of the purely physical skill I have acquired at escaping from restraint. However, by trickery I can make it appear that I am able to read your mind, to transfer my thoughts, to establish communication with the dead and so on."

Houdini excused himself for a moment and returned with a blank slate. We sat at opposite sides of a small



The Modern Aladdin

Never has there been made a pair of handcuffs from which Houdini could not quickly escape by his mystifying and skilful magic

table, and he thrust the slate beneath it and requested me to take hold of it. An instant later there came a scratching sound from under the table. When this ceased, Houdini released his hold on the slate and bade me raise it and look at it. The slate contained my name, home

address, and home telephone number, written in chalk!

"Mystifying, isn't it?" inquired Houdini, laughing at my expression of astonishment. "You'd almost believe me, wouldn't you, if I told you a spirit wrote that? Well, I'm the spirit that did it.

"Look here," he directed, thrusting his hand beneath the table and drawing out a second slate. "This," he said, "is the slate you saw me bring into the room. The slate you have in your hands was under that table for several hours—message and all. I wrote that message when you phoned me that you were coming here. It was an easy matter for me to get your home address and telephone number from the directories when I knew your name and occupation. When I asked you to hold the slate with me under the table, I made a 'switch,' handing you the prepared slate, which I released from a clamp that held it against the under side of the table and placing the blank slate in the clamp. The writing sound you heard I made with my finger nail on the surface of the blank slate.

"That, of course, is a very simple trick; yet through it I probably could have convinced you that I was a mind reader, a medium, and what not. Just a moment, and I'll show you something even more astonishing. Write a message on that blank slate, and let me see it."

The message I wrote was:

"Houdini is the most mysterious man in the world."

"Thanks," smiled Houdini as he read it. "I hope I deserve the compliment. Now turn the slate face down, and don't let any one see it."

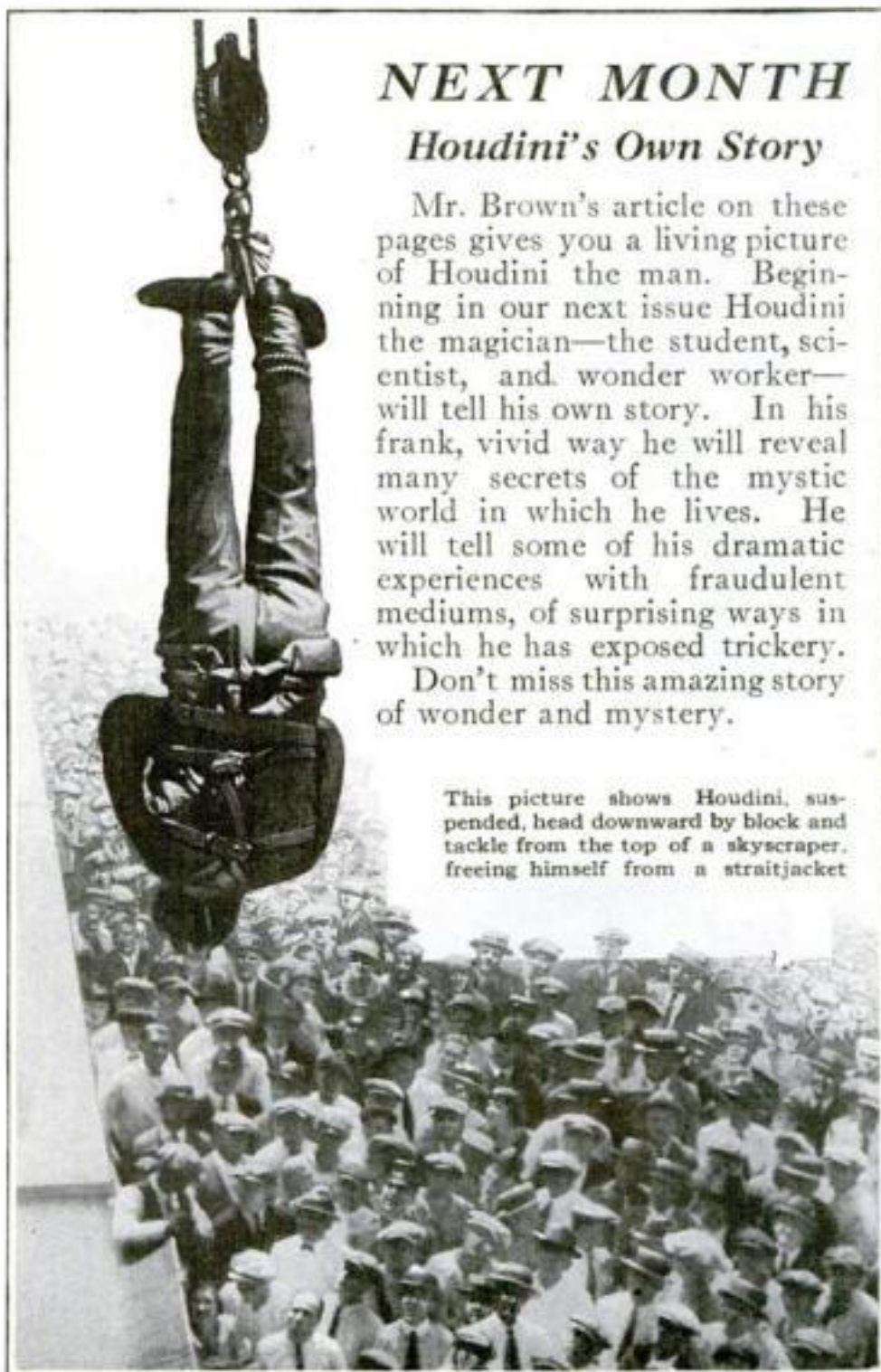
He walked to the door, and called upstairs, requesting Mrs. Houdini to join us. When she came in, her husband presented me to her, the three of us exchanging the polite commonplaces that are customary on such occasions. Not once that I could notice did Houdini make a signal or voice anything beyond the conventional remarks incidental to introducing a guest in his home to his wife; yet not more than 20 seconds after she had entered the room, Mrs. Houdini turned to me, smiled, and said:

"You wrote on that slate, 'Houdini is the most mysterious man in the world.'"

"How on earth did you tell her that?" I demanded of Houdini after his wife had departed.

"By natural, physical means," he replied. "Mrs. Houdini and I used to do a mind-reading act, and have a secret code of communication—made up entirely of natural gestures, words, and so on—which permits us to exchange the most complicated messages in the presence of others without detection.

(Continued on page 154)



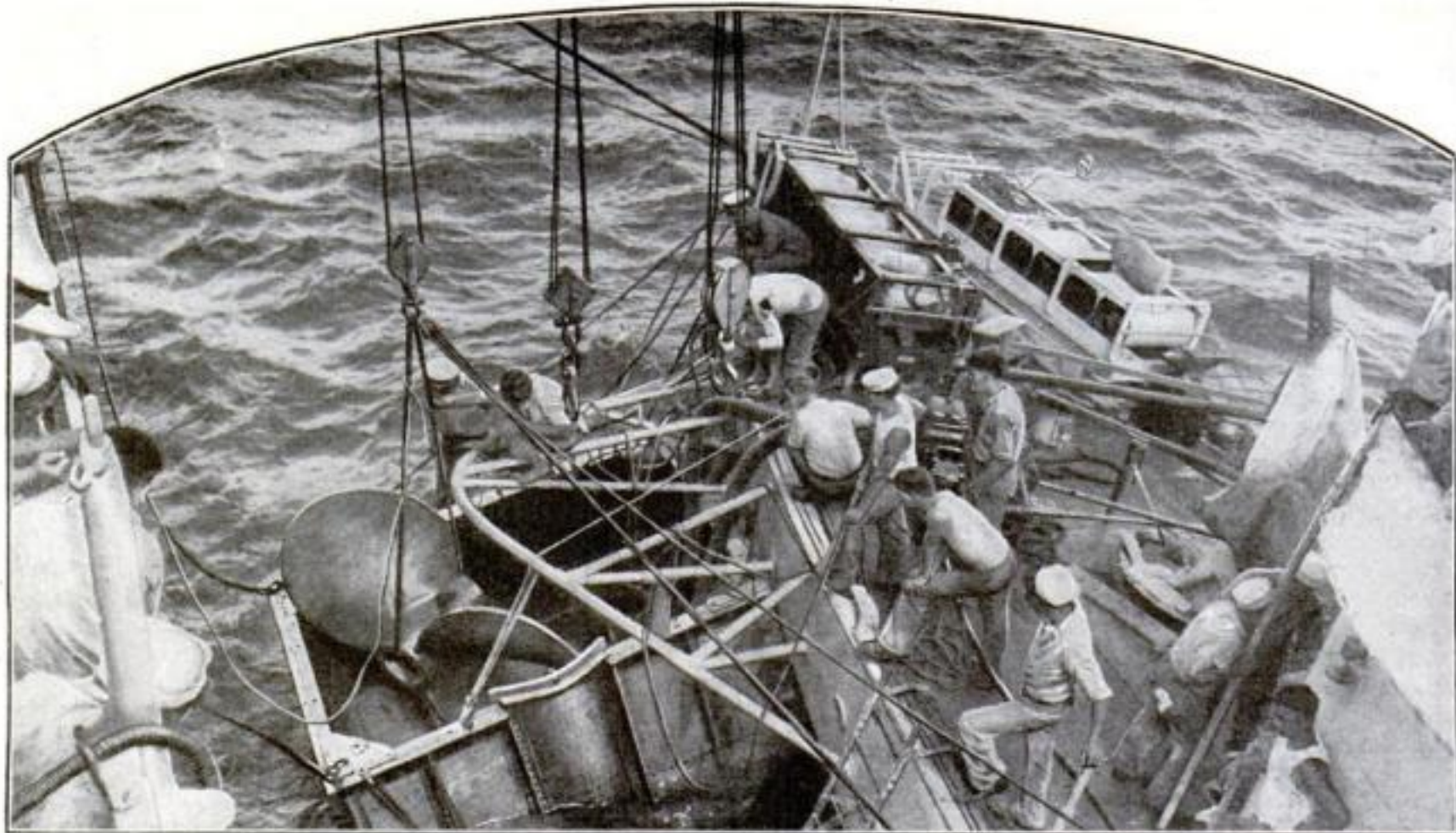
NEXT MONTH

Houdini's Own Story

Mr. Brown's article on these pages gives you a living picture of Houdini the man. Beginning in our next issue Houdini the magician—the student, scientist, and wonder worker—will tell his own story. In his frank, vivid way he will reveal many secrets of the mystic world in which he lives. He will tell some of his dramatic experiences with fraudulent mediums, of surprising ways in which he has exposed trickery.

Don't miss this amazing story of wonder and mystery.

This picture shows Houdini, suspended, head downward by block and tackle from the top of a skyscraper, freeing himself from a straitjacket



Lowering Away the Floating Caisson

Repair ship standing by U. S. S. McCormick (left) to replace damaged propeller, weighing 6500 pounds. This remarkable feat was performed in the Pacific Ocean by means of a floating caisson and sailor-divers

Uncle Sam's Cruising Repair Shop

Destroyer's Broken Propeller Ingeniously Replaced in Mid-ocean

DURING the recent naval maneuvers in the Pacific, there was performed on the destroyer McCormick one of the rarest and most difficult operations of modern seamanship—changing a damaged propeller while on the high seas.

In 4½ hours the old propeller had been removed, a new one put in its place, and the destroyer was ready to proceed on its way. This extraordinary feat was made possible by a special type of caisson invented recently by Lieut. William O'Neill at the Philadelphia Navy Yard.

Damage to propellers is not infrequent among the smaller vessels of the navy. Constant vibration sometimes causes a propeller to crystallize and throw one of its blades. Or one or more of the blades may be clipped off by striking a submerged rock or bit of wreckage. Even if the blades are not broken, if one is badly bent, the resulting vibration to the vessel is so tremendous that the destroyer cannot make good speed and the propeller must be replaced.

On both the Atlantic and Pacific oceans there are cruising repair ships for both destroyers and battleships. If one of these happens to be within radio-calling distance, it will bring a new propeller and caisson and the work can be done on the open sea.

It would be possible for a ship to make its own repairs if it had the equipment, but extra propellers weighing many tons and the caisson needed for the work,

weighing about 2½ tons, would be decidedly in the way on a destroyer.

The repair ship draws up alongside the destroyer and lowers the caisson at the stern of the destroyer by means of leading and guy wires. The caisson is about 12 feet deep and long enough to contain the propeller and a short section of the propeller shaft.

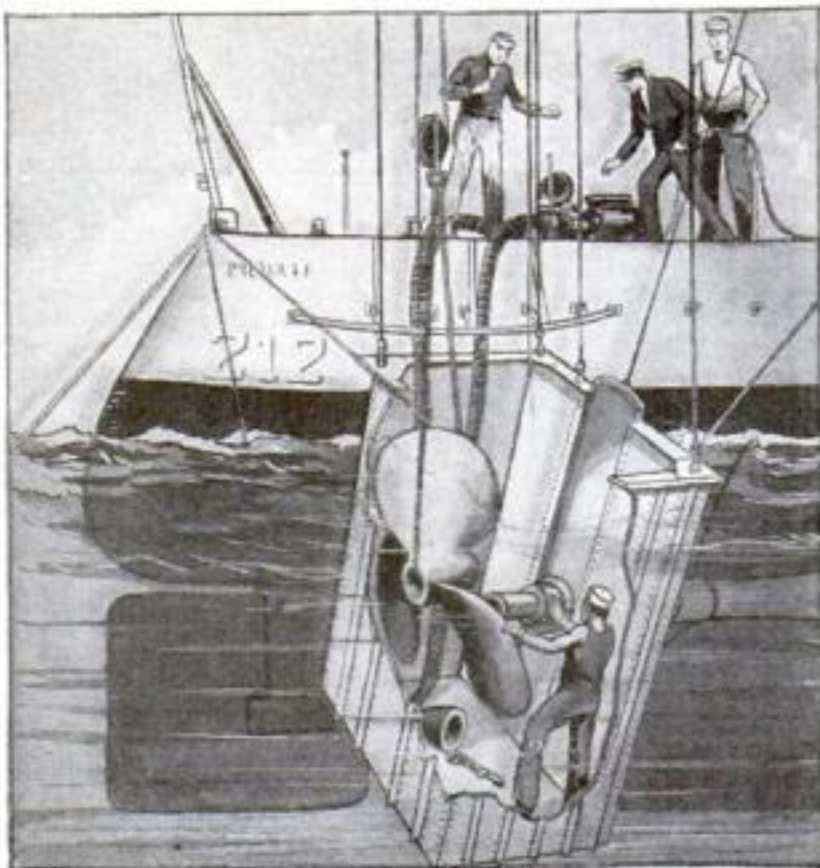
The submerged caisson slips up under the propeller from the stern and is brought up so that the upper edge is about three

feet out of water. The propeller shaft slips halfway down the box in a slot that curves at the bottom to fit the shaft. After the box is in position, a door slides down the slot, filling the opening. The bottom of the door is curved, fitting the upper part of the shaft.

A diver then descends into the box and calks the crack between the shaft, caisson, and door, so that the box becomes water-tight. Every destroyer carries diving equipment and at least one or more seamen gunners trained as divers. Divers are needed to free anchors or recover torpedoes that have been shot into the mud and that may be used again. The diver passes a line about the latter and they are drawn back to the ship.

All the water is pumped out of the caisson, and one or two men remove the damaged propeller. A nut and locknut hold the propeller on the shaft. These are covered with a pointed cap of light metal. These parts are removed by means of a sledge hammer and iron bar and the propeller is driven off. The weight of the propeller is supported by a line from the repair ship.

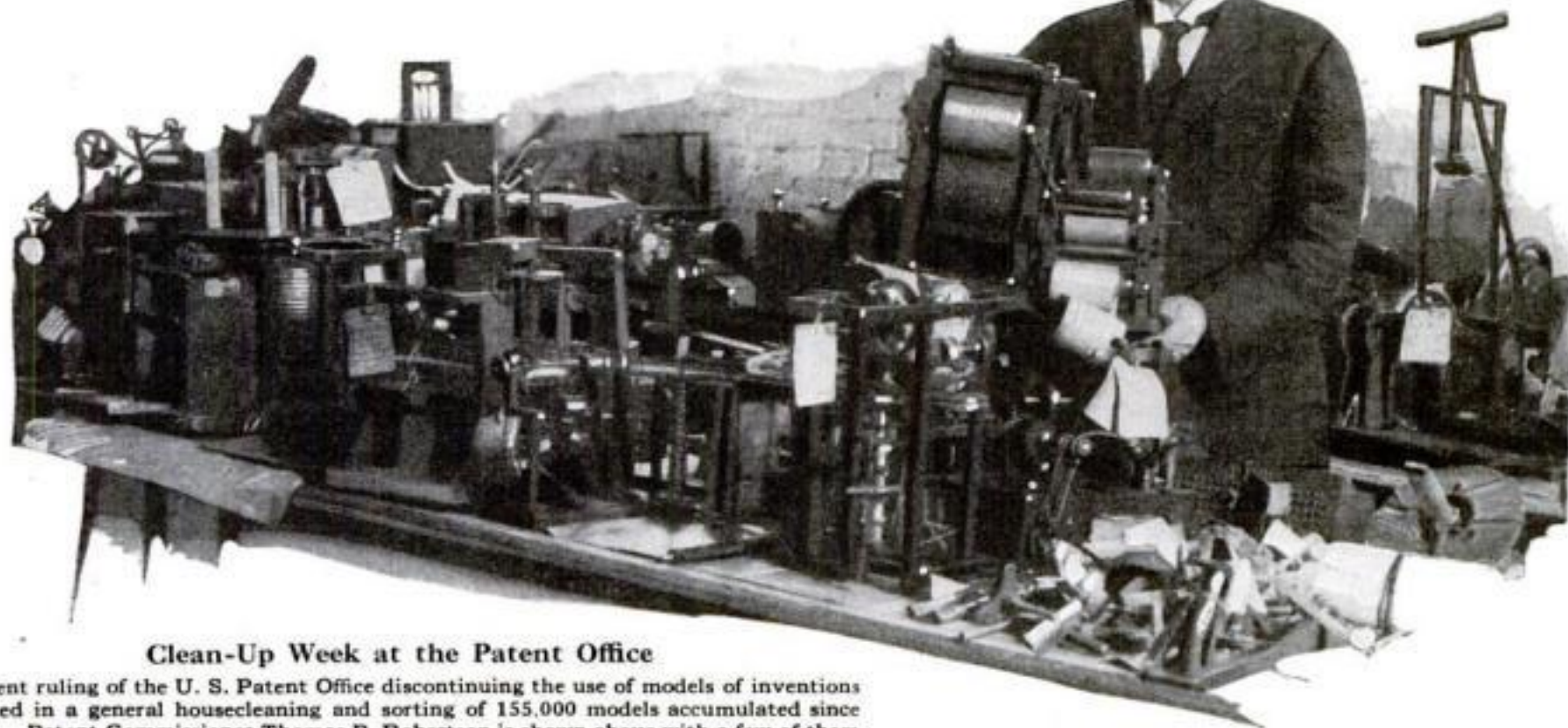
It is easier to slip the new propeller into place than to remove the damaged one. Some destroyer propellers are not welded in one piece, but have separate blades. In such cases it is necessary only to replace the blades that have been damaged. One of the propellers changed on the McCormick weighed 6500 pounds.



How the caisson is adjusted to propeller shaft by a sliding slot that is tightly calked until new propeller is in place

Some Snares for Inventors

How to Avoid Pitfalls and Protect Your Ideas—What a Patent Really Is



Clean-Up Week at the Patent Office

A recent ruling of the U. S. Patent Office discontinuing the use of models of inventions resulted in a general housecleaning and sorting of 155,000 models accumulated since 1884. Patent Commissioner Thomas P. Robertson is shown above with a few of them

By Frank Parker Stockbridge

WITH "blood in his eye," a man walked into the office of a famous patent attorney. His hands indicated that he was a mechanic; his clothing, that he had "dressed up" for the occasion.

"See this advertisement of the sky-high carburetor?" he demanded. "I've got a patent on that, and I want you to sue 'em for me for a million dollars. Here's the official copy of my patent—'June 18, 1920, to John P. Smith.' I'm Smith."

The attorney studied the advertisement, taken from an engineering periodical, which showed a detail drawing of the sky-high carburetor. Then he looked over the patent papers.

"Just where do you claim there is an infringement, Mr. Smith?" he asked at last.

"Why, in the method of controlling the air supply," replied his visitor. "See the way they show it in their picture? Now, that's just the way it is in my patent."

The attorney studied the patent papers again, but his attention was fixed on the printed text instead of on the drawing.

"I don't find anything in your claims covering this method of air control," he said finally. "If this is all you have, Mr. Smith, I'm afraid you haven't much chance to collect that million."

Smith turned pale. "But—but it was in my application, all right," he stammered. "That's my whole invention—all these other things are just details. And it shows right there on the drawing. Do you mean to tell me my patent's no good?"

"It's a good patent, as far as it goes," the attorney answered; "but it doesn't go far enough. Didn't your original attorney advise you that your application had been amended?"

"Why, I did have some letters from him, but I don't remember now what was in them," the visitor admitted. He left, worried, promising to bring all the correspondence.

"What Smith thought he had invented and received a patent for wasn't what his patent described at all," said the attorney, telling me of this incident. "Among the papers he brought me was a letter from his former attorney, telling him that the claim in the original application covering a method of air control had been disallowed by the Patent Office on the ground that it was old. He could use it, if he wanted to, but so could the sky-high people or any other manufacturers of carburetors. It showed on his drawing, because it helped demonstrate the action of his actual inventions, which were patentable, but not of any particular commercial value, since the same results could be accomplished more simply in other ways."

SMITH had fallen into one of the pitfalls with which the way of inventors is beset. He did not read his patent claims, but took it for granted that they covered what he thought they covered. In this country a patent covers nothing but what is set forth in the claims allowed, and there is no way to correct a mistake in the claims but to apply for a reissue. In England and on the Continent a court in which the validity of a patent is challenged will take judicial notice of the inventor's intention.

"No matter what you have invented, if it isn't described in your patent claims, you haven't got a patent on it."

Failure to recognize this important factor cost Renaud, the French inventor

of the automobile gear-shifting mechanism now universally used (except on Ford cars), the enormous fortune he could have collected in royalties from American automobile manufacturers.

"WHAT good is a patent anyway?" I asked another attorney who had been practising before the Patent Office for 30 years.

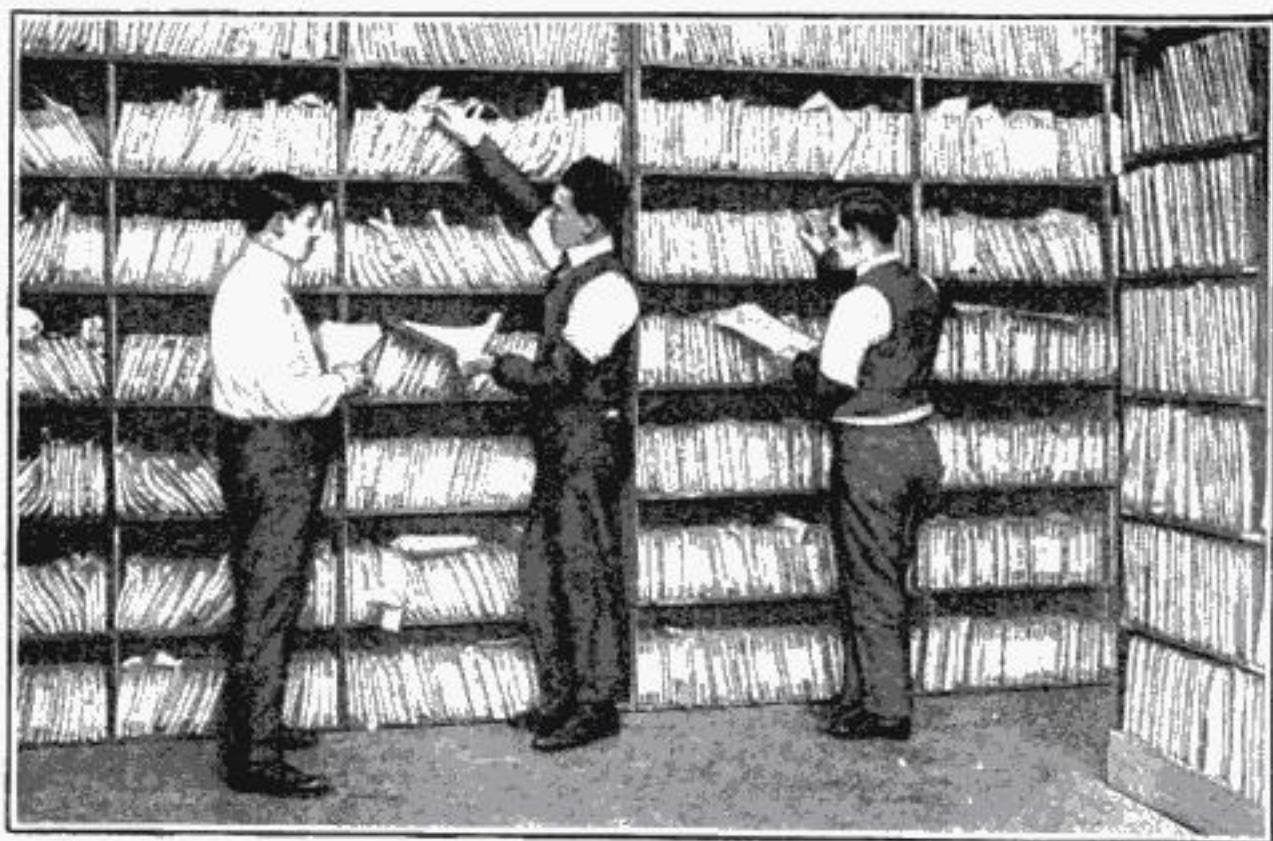
"If you've got a good invention, a patent is a protection—until somebody else proves that he invented it before you did," he said. "A patent has been described as 'a license to sue and to be sued.' If your invention is good, somebody else is going to claim that he saw it first. And if he can make that claim good, you're sunk."

"Most inventors make the mistake of thinking that a patent is a guarantee that their invention is valuable. It isn't anything of the kind. Of every 1000 patents issued, 900 are without commercial value."

"Then what does a patent prove, anyway?" I pursued.

"It proves only that the specific thing described in the patent claims has not been done or described in that precise way before, so far as the Patent Office experts know or can find out," was his answer.

IT SOMETIMES happens that a valuable invention is not patentable because it has been described in print so that any one could do the same thing. That happened when Morgan Robertson, writer of sea stories, applied for a patent on the submarine periscope. Mr. Robertson went one day with Lewis Nixon, shipbuilder, who was constructing the first Holland submarines for the navy, to see the new craft. "We've been trying to work out a scheme whereby the captain can see where he is going without coming to the surface,"



The Storehouse for 1,500,000 Ideas

Nearly a million and a half patents are contained in the vast files of the U. S. Patent Office, which issues about 40,000 annually

said Mr. Nixon. Mr. Robertson immediately suggested a telescoping tube with mirrors set at the proper angles, that could be shoved up to the surface when the submarine was submerged—practically the periscope, now an essential part of every submarine's equipment.

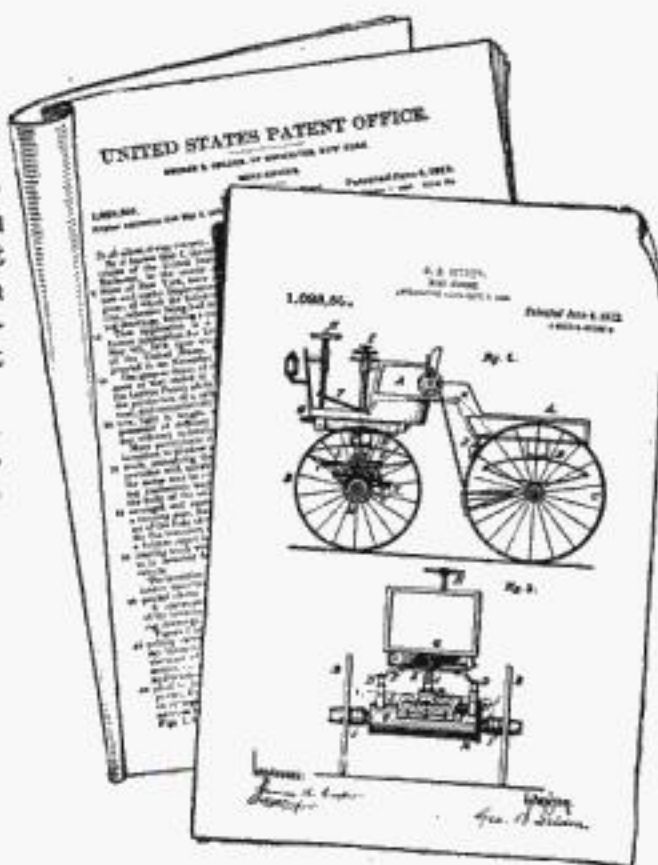
"You've got it!" Mr. Nixon exclaimed. "I'll have one made and we'll get it patented in your name and we'll pay you so much for every one made."

ROBERTSON saw a fortune coming his way; but at the Patent Office, the examiners turned to a copy of Jules Verne's "Twenty Thousand Leagues under the Sea," published years earlier, in which an entirely mythical submarine was equipped with an equally mythical periscope, worked just as Robertson had imagined it. The description was so detailed that the device was obvious, the Patent Office held.

The same sort of an objection was raised in the case of the balloon tire patent recently issued to an inventor after balloon tires had been in use for several years and their principle had been discussed in print for years before. In this case, however, the Patent Office held that the invention was not obvious from the articles that had been published; and of course the application had been filed long before the first balloon tire was made.

Many inventors have lost fortunes by neglecting to make any records of the dates when the inventions first took shape in their minds. A simple sketch or a brief written description, dated, signed, and witnessed by one or two friends, may establish a claim to priority when somebody else claims to have invented the same thing before the patent application was filed.

It is not at all unusual for two or more persons to invent the same thing about the same time. Where two or more persons have applications pending for patents covering the same ground, the one who can produce proof of the earliest date of invention gets the patent. Often, however, after a patent is granted, it is challenged on the ground that the same



A Historic Patent

One of the most widely heralded patent suits was that which cost G. B. Selden half a million dollars and the loss of royalties as the sole inventor of the gasoline "road engine." A copy of a renewal of the original Selden patent, with drawings, is pictured above

thing was being done in industry before the inventor's application was filed. Then proof often is not easy to get.

MANY years ago a man named Smith died in Buffalo, N. Y. He had run a bicycle repair shop in Washington, D. C. His executors sold his business and all the assets were bought by another bicycle dealer named Owen. Included in the property were some patents. These Owen handed to his brother-in-law, a patent attorney, to look into. One of them was apparently a basic patent covering a method of hanging the bicycle crankshaft, the method then used by every American bicycle manufacturer, and still in use.

Suit for infringement was brought against some of the leading manufacturers, and they faced the likelihood of having to pay out a fortune for infringements of a patent, the existence of which they had not known. Then an

English mechanic, working in Boston, came forward with an English crank-hanger just like the patented article, and declared that he had brought it over from England with him a year before the date of Smith's patent application. Several of his fellow workmen made affidavits that they had seen the device in Smith's hands at that time. The manufacturers decided to defend the suits.

But Owen and his attorney were not discouraged easily. If they could find Mrs. Smith, she might know when the invention had been made. But Mrs. Smith had vanished. A search of the vital statistics in Buffalo resulted in finding that Smith had died at a boarding-house that had changed hands. The former landlady was discovered. She remembered that when Mr. Smith died, Mrs. Smith's married sister also lived in the house.

It took weeks to trace the married sister. Through her it was learned that Mrs. Smith had gone into a convent at Batavia. But she had the keys to a trunk, in which was found a signed, witnessed drawing of the crank-hanger, dated months earlier than the application for the patent.

BUT still there was that English device of an even earlier date, if the Boston mechanic's story was true. Owen's attorney suspected that the mechanic was lying. And, on the day when the case came up in court, the manufacturers' attorneys got a letter from the mechanic admitting that he had falsified the date of his arrival in America by a year and had bribed the other witnesses. The dated drawing proved that Smith had invented the device before the first recorded use of it anywhere, and the manufacturers pooled their interests and bought the patent from Owen for \$285,000.

A still greater fortune may be waiting for the inventor of the demountable automobile rim, now universally used, who lost his evidence of priority and couldn't find it for 16 years. His application was filed in 1907 and his patent granted in 1916. Its validity was questioned because such rims had been in general use for years and there was evidence that they had been thought of before 1907.

Somewhere, the inventor knew, he had a drawing and description, properly signed and witnessed, dated earlier than that earliest date on which anybody claimed to have any prior evidence. Where it was he could not remember.

Without written evidence of priority of invention the inventor could not sue to collect from everybody who had made and used demountable rims since his patent was applied for. Then, a few weeks ago, he found a perfect drawing, properly signed, witnessed, and dated!

In contrast to the inventor who loses because his claims are not sufficiently specific, one of the largest amounts ever involved in any litigation of a single patent was lost by the inventor because his claim was too specific! This was the famous Selden patent on the automobile. On the face of it, the Selden patent, issued in 1895, covered any kind of an automobile propelled by a gasoline engine. From 1901 every automobile manufac-

(Continued on page 160)

This Woman Expresses Her Ideas with Anvil and Hammer



The Family Crest

John Held, Jr., designed this sign; Mrs. John made it in iron, and John says it tells the family story

By Newton Burke

ALTHOUGH there may have been women blacksmiths in the past, it is unlikely that any female Vulcan of bygone days ever succeeded in combining mechanical skill in blacksmithing with a well developed artistic sense in just the way this has been accomplished by Mrs. John Held, Jr., of Westport, Conn.

Mrs. Held, through her own amazing skill with hammer and anvil and with the assistance of her husband, a well-known artist and illustrator, literally has created a growing business out of nothing but ideas and sheet iron.

It all began, as do so many commercial enterprises, with a desire for something apparently not obtainable in the open market. Mrs. Held decided that there ought to be a sign on the gatepost of their farm. A painted sign would not do. Anybody could have a painted sign.

A family consultation was held to settle this important matter, and John Held, Jr., jokingly suggested that since she wanted something different, she might put up an electric sign!

"While we were still arguing," said Mrs. Held, "Mr. Held handed me a sketch with the remark that it illustrated a true state of affairs, as well as being individualistic.

"After considering about every possible way in which a sign could be made," she continued, "I decided to try my hand at making it out of one solid piece of iron. My previous experience had been limited to hammering brass and similar light metalwork. The first attempt got messed up so badly, I had to throw it in the scrap pile. The second was almost finished when a misdirected blow of the hammer broke off part of one of the figures. By that time I had acquired sufficient skill to do the work properly, and the third sign was a success.

THE sign looked so well that I was encouraged to tackle other jobs, such as that fire screen, the standing lamp beside you, and those door hinges."



Mrs. John Held, Jr., before Her Sample Board

Wife of a widely known artist, Mrs. Held at first wrought articles in iron for the decoration of her home. Enthusiastic friends told of her skill at the forge, and thus started a flourishing business

Mrs. Held is tall and willowy, so unlike the person I had imagined—a sort of sister to Longfellow's village blacksmith, "with large and sinewy hands, and the muscles of her brawny arms as strong as iron bands"—that I had to ask her about it.

"Blacksmithing is not so much a matter of muscle as it is of knowing how to apply

"Under the Spreading Chestnut Tree"



Mr. Held's conception of his wife at work—a twentieth-century version of Longfellow's poem, "The Village Blacksmith"



Weather-Vane and Sign

Examples of ironwork made at Mrs. Held's forge. Each design is original and each is made by hand

what muscle you have in just the right way," replied Mrs. Held. "Of course, if I kept at it steadily, I suppose soon I could pose for one of those muscle-building advertisements.

BUT, you see, I don't have to do that. At first, when our friends began asking me to make articles that can be made most artistically in wrought iron, I worked like a slave, but later I trained assistants to do the work my way."

"So now it has become a regular business?" I prompted.

"In a way it has," Mrs. Held answered; "that is, I have a regular staff of blacksmiths, who devote a good part of their time to making up the gate signs and

other things Mr. Held and I have designed, but the shop still is an old fashioned blacksmith shop, where horses are shod and the usual country blacksmithing jobs take up some of the time. Of course, you understand that the work still is carried on by hand. No modern duplicating machinery is used, and every piece is necessarily just a little bit different from another, even when they both are produced from the same design."

"But hand work means high prices, and high prices, I should think, would scare many possible purchasers," I suggested.

THAT'S true, but then you must remember that our gate signs ought to last for years and years. They are far more durable than signs made of wood and painted in the usual manner.

"The fact that they are so extremely durable has brought us a number of orders from towns and cities for signs to mark the intersections of streets. The kids can shy rocks at them until they wear out their arms without hurting the signs in the least."

Mrs. Held and her assistants can complete only about two signs a day. She is content to turn ideas and iron into useful and artistic objects, and to make a small profit while doing it.

Science Mines the Ocean

By Edgar C. Wheeler

*Tons of Gold,
Sunken Treasure,
Rich Minerals,
Huge Food Stores,
and Lakes of Oil
Challenge Man*



How Science Salvages Treasure

An expedition now is working to recover \$5,000,000 in gold from the steamship *Merida*, sunk off Virginia in 1911. A large hole is being cut alongside the strong-room, the door of which will be dynamited. Divers will load the treasure—weighing about 30 tons—into one-ton wicker baskets, which will be raised by strong pulleys

of the fascinating chances of fortune in store for the modern prospector who digs down into mysteries of the unknown deep.

The vast expanses of water are saturated with valuable salts and minerals. And they literally are swarming with living things, both plants and animals, far outnumbering the life of the land. Lying beneath these myriad forms of life are great mountain ranges, volcanoes, valleys, and plains that form the floor of the sea. Strewn over this uneven floor, buried in shifting sands and held in the slime of dead things from above, are countless carcasses of wrecked ships that have gone to their doom laden with rich cargoes.

Cognizant of these immense possi-

*Neptune Beckons
Hardy Venturers
to the Greatest
Test of Human
Ingenuity in the
World's History*

bilities, Uncle Sam's Navy is embarking on a far-reaching program of ocean research. As a first step, the U.S.S. *Rainbow* is being fitted out for an expedition to the Gulf of Mexico and the Caribbean Sea. The announced purposes are to chart the ocean floor and to discover and develop for immediate use some of the sea's hidden resources.

ONE of the most fascinating efforts of the expedition is toward the location of oil fields in the vast realm under the great blanket of water. The navy already has located and charted places in the Gulf of Mexico where oil spots constantly appear. With the oil fields of the land nearing exhaustion, the economic importance of such a potential discovery is obvious.

Scientists have determined by study of land oil fields that the presence of fossils of small shell-like animals, called "foraminifera," is a highly accurate indication of oil-bearing strata. The *Rainbow* is equipped to study the geological formation of the sea bottom and to bring up samples of the fossils below the bottom at spots indicated on the charts.

The resources sought by the *Rainbow* include, beside oil and the myriad living things, vast stores of inorganic matter—salts, minerals, chemical elements. Whether the extraction of gold from ocean water by Professor Haber's process ever will prove commercially practical, there is no question that the sea is a tremendous potential commercial

source of common salt, potassium, magnesium, and calcium salts, iodine, and bromine.

AT THIS moment one of the strangest ships afloat, the *Ethyl*, is mining the ocean for bromine, an element used in medicine, in photography, and in the manufacture of motor fuel. The *Ethyl* pumps aboard 7000 gallons of sea water a minute, and from each 1700 gallons is extracted one pound of bromine. Other ships, it is reported, will be equipped similarly to mine this valuable element.

Truly, there are fortunes locked in Neptune's vaults and the number of modern prospectors of the sea is increasing

FIVE-SEVENTHS of the world's surface has never been explored. Hidden millions of mysteries have beckoned to man for centuries from this vast area covered by the waters of the oceans.

Now, however, spirited venturers in the fields of science are reading the secrets of the sea. They are finding, not only new methods of locating sunken treasure, but also how to prospect for new resources that can be turned to the use of mankind.

One scientist says he has found a way to sift pure gold from the salt waters. As an eager prospector would search among quartz hills, this scientist—Prof. Fritz Haber, of the University of Berlin—literally is following veins of gold, silver, and other precious metals running through the oceans. And in this venture he is enlisting the cooperation of the U. S. Bureau of Fisheries.

Gold! Thousands of millions of tons of it carried in the foaming surf that pounds the beach; tossed about in mountainous waves of mid-ocean; hidden in miles of watery depths.

NO SUCH staggering dream of wealth ever lured the hardy adventurers who staked their lives in the reckless gamble for fortune in the California hills or down the Yukon. It seems unreal, fantastic.

It has been found that water from the Atlantic Ocean contains from .015 to .267 part of gold to each million parts of liquid. Water from certain parts of the ocean contains nearly twice as much gold as the lowest grade land gold deposits profitable to operate.

Captain F. B. Bassett, hydrographer of the U. S. Navy, is authority for the recent statement that billions of tons of gold are dissolved in ocean waters in a concentration of from half a grain to one grain to every ton of water. This represents about \$10 worth of gold in every 250 to 500 tons of ocean waters.

Will the day come when we shall see great ocean mines where men will dip into miles of sea and extract from vast volumes of its waters the gold it conceals?

No one can answer these questions with certainty today. Nevertheless, Professor Haber's claims give us some inkling



Mechanical "Ear" to Find Pirates' Gold

William J. Beach, a Canadian, recently perfected a radio device with which he hopes to locate pirate treasure sunk off Cocos Island in the Pacific. Mr. Beach is shown with his instrument and the 26-foot vessel in which he has embarked for the South Seas

daily. Probably never before in history was there a "gold rush" so feverish as that which now is luring adventure-loving men away from solid ground.

Fortunes are gambled and lives are risked in hazardous attempts to retrieve millions in gold and jewels from the hulks of sunken ships. Wealthy men are spending other fortunes equipping expeditions to study the teeming sea life and the luxuriant vegetation miles below the sea's surface. Still others are searching the waters of the Mediterranean for the riches of cities that we engulfed centuries ago.

MARVELOUS diving chambers have been devised to permit men to work and explore freely under the tremendous pressure in the deep caverns of the ocean. Undersea cameras now are available to record ocean wonders. Ingenious depth-finding apparatus is giving us accurate contour maps of the floor of the ocean. Radio is being employed in attempts to reveal the spots where sunken treasures are hidden.

With these elaborate tools, the ocean prospector is finding his field almost limitless. Just remember that five-sevenths of the earth is covered by the oceans and in the oceans are 302 millions of cubic miles of water!

In sunken ships alone fabulous rewards beckon the fortune-hunter. Recent inventions make this form of prospecting something more than a wild guess and a perilous plunge. Armored diving-suits and working chambers are making it possible to go down far beyond the 200-foot depth, formerly the limit of human endurance.

Improved deep-sea pumping apparatus also is making it possible to remove tons of sand with which Neptune holds many a treasure hulk in tight grip, and to wash

this sand for bits of precious metal, much as miners wash the sands of streams for grains of gold.

Within the next 10 years it is predicted, more wealth will be recovered from sunken ships than in all the preceding ages in the world's history.

Perhaps the achievement that did as much as anything to encourage the present stampede of ocean prospectors was the spectacular success of divers in recovering the \$30,000,000 cargo of gold from the wreck of the *Laurentic*, sunk by a submarine off the coast of Ireland in 1917. Other ships of comparatively recent sinking have given up much of their treasure because science has found ways to reach depths never before attempted. Thousands more await the salvager.



ALONG our own Atlantic Coast lie at least a dozen of these wrecks with strong-rooms full of gold waiting the first comers. At this moment four young Americans are exploring what is probably the richest of these prizes—the wreck of the *Ward* liner

Merida, sunk in collision off the Virginia capes in 1911 with gold, silver, copper, and jewels worth from \$2,000,000 to \$5,000,000. Dragging a mile-long iron sweep along the floor of the ocean, the trawlers *Foam* and *Spray* located this prize several months ago. And now, using the most modern of armored undersea apparatus, divers are at work to recover the treasure.

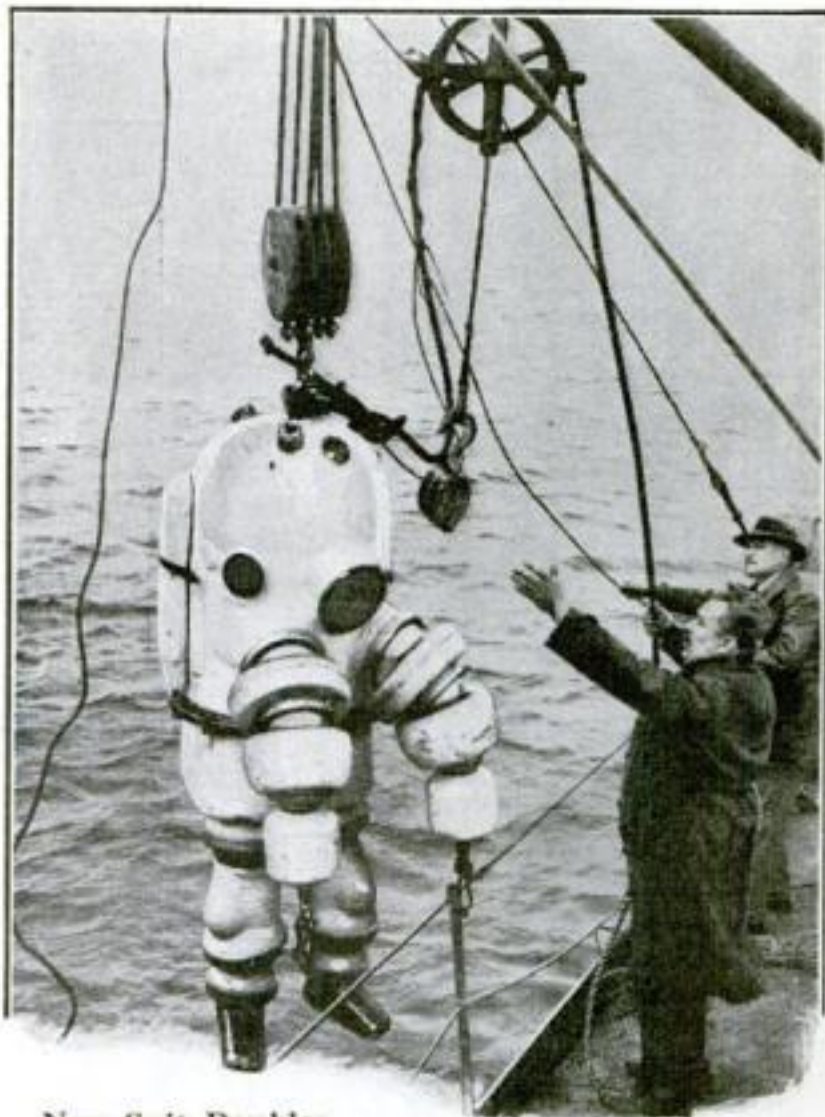
YET tremendous as is sunken wealth, it is actually small compared with the enormous natural resources of the sea in animal and vegetable life and in minerals. Scientists have counted more than 19,000 different varieties of fishes, some of which, like the menhaden and herring, are caught by the millions each year. Every year we haul millions of dollars' worth of products from the sea—foods, oils, fertilizers, pearls, leather, shells, glue.

We have barely touched its natural riches, and we have just begun to discover its hidden wonders, packed in layers upon layers, one farm and feeding ground above another, each level with its own forms of plant and animal life. The immensity of such a vast storehouse staggers our imaginations.

HERE again is a compelling challenge. And the challenge is being accepted by science in a manner which, for dramatic episode and thrilling adventure, rivals any of the gripping tales of fiction. The most fascinating figure in this new drama is William Beebe, curator of ornithology of the New York Zoological Society. In previous issues of *POPULAR SCIENCE MONTHLY* you have read of his wonderful explorations on barren Galapagos Island—the "world's end"—and of his voyage of discovery into the Sargasso Sea, that ocean wilderness in the Atlantic. Now, having fished from the depths amazing creatures that never before had been seen, he returns home to report his finds and to prepare for new adventure.

And for picturesque setting and lively romance, the new adventure promises to surpass anything in deep-sea mining. This is indicated in the recent announcement that Harrison Williams, New York financier, has purchased the palatial million-dollar yacht *Vanadis* (to be renamed the *Warrior*) and is transforming her into a wide-cruising laboratory from which scientists will plumb the undersea for fresh wonders.

Truly the sea still remains the great frontier of the world. On earth the spots that remain undiscovered can be counted on one hand. But the ocean is still mostly mystery—deep, dark, wonderful, rich.

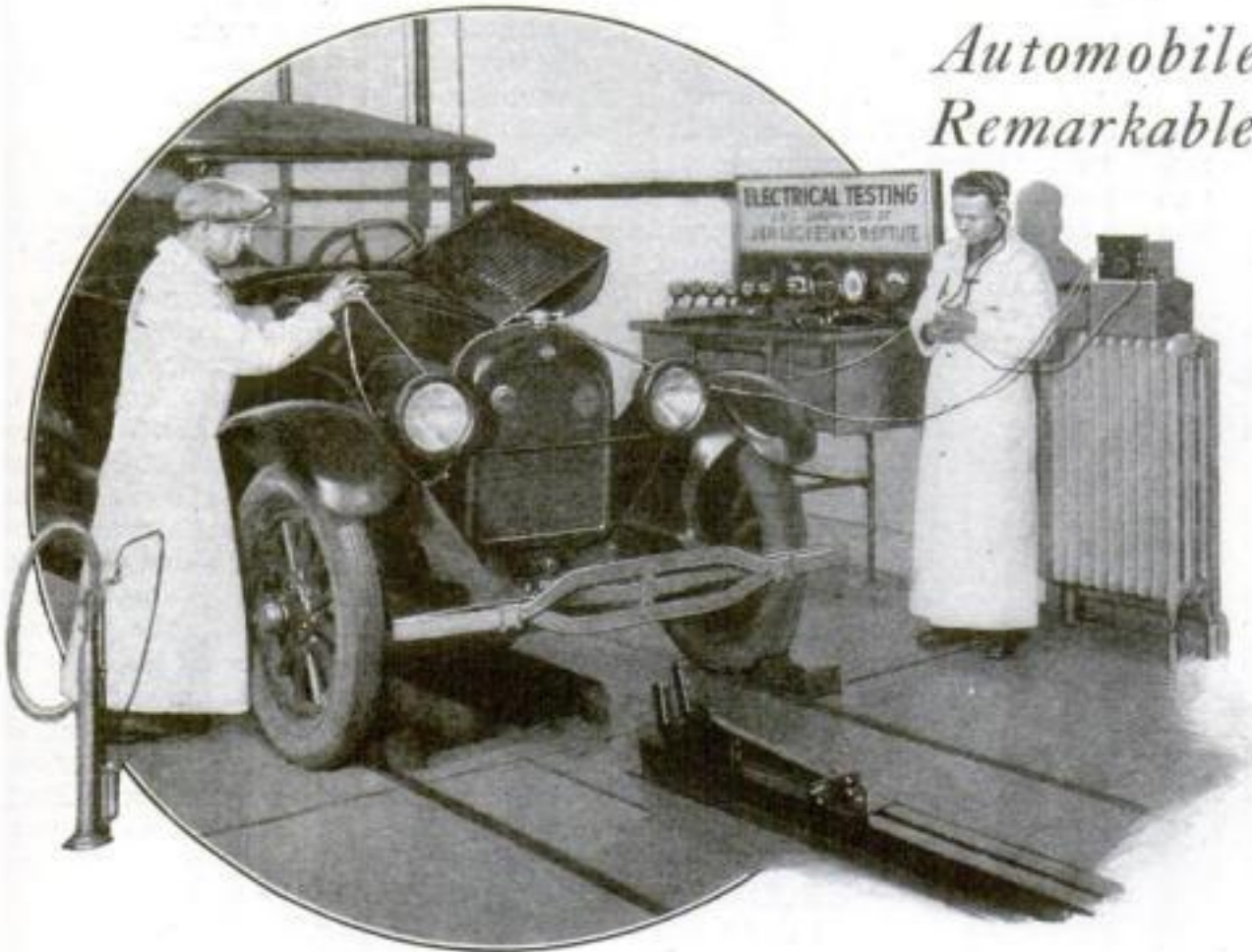


New Suit Doubles Diving Depth

This strange-looking steel-and-aluminum diving-suit permits a descent of 600 feet—almost twice the distance formerly possible

A Mechanical Doctor for Motor-Cars

Automobile Ills Diagnosed in Remarkable Chicago "Hospital"



Listening for Knocks in the Heart of a Car

The "doctor" at the left is holding a special stethoscope connected with a vacuum-tube amplifier, through which the man at the right, with head phones, listens for engine knocks

By Fritz Blocki

A MECHANICAL doctor for diagnosing practically any ailment of an automobile and for detecting any symptom of minor "illness" to which it is subject, is one of the newest contributions of science toward increasing the efficiency and prolonging the life of the motor-car.

This remarkable new apparatus, the invention of F. E. Edwards, of Chicago, automatically puts a car through a thorough physical examination with exacting test instruments, to determine the working efficiency of its various parts, much as a physician puts a human patient through exercises and movements to test his respiration, temperature, blood pressure, and other indices to his health.

Here are a few of the things that the mechanical doctor finds out about a car: Knocks are located; electrical conditions tested; the horsepower is measured as it is delivered to the rear wheels; the amount of friction in the motor, the rear wheels, and the axle determined; the condition of the wristpins, connecting rods, and pistons is ascertained, compression of cylinders measured, and the amount of dilution in the crankcase oil examined.

A "DIAGNOSIS" is made as follows: The car is driven on the testing apparatus so that the rear wheels rest on two large revolving drums set into the floor of the laboratory. These drums are geared with a device for measuring horsepower, known as a "dynamometer."

The car is put in high speed and the throttle opened wide. Resistance then is thrown against the driving wheels through the dynamometer, thus making the car

"climb" the steepest hills. Then the amount of torque, or pounds of pull exerted by the car on the dynamometer, is measured. Since it is known how much horsepower the motor itself develops, any loss of power may be determined, after which the trouble is traced and directions given for eliminating it. Any knocks that develop under load are located.

Again the dynamometer is used, this

time as a motor, to turn over the wheels of the car with its ignition turned off. The amount of torque once more is measured, giving the amount of friction in the rear axle, drive-shaft, and motor.

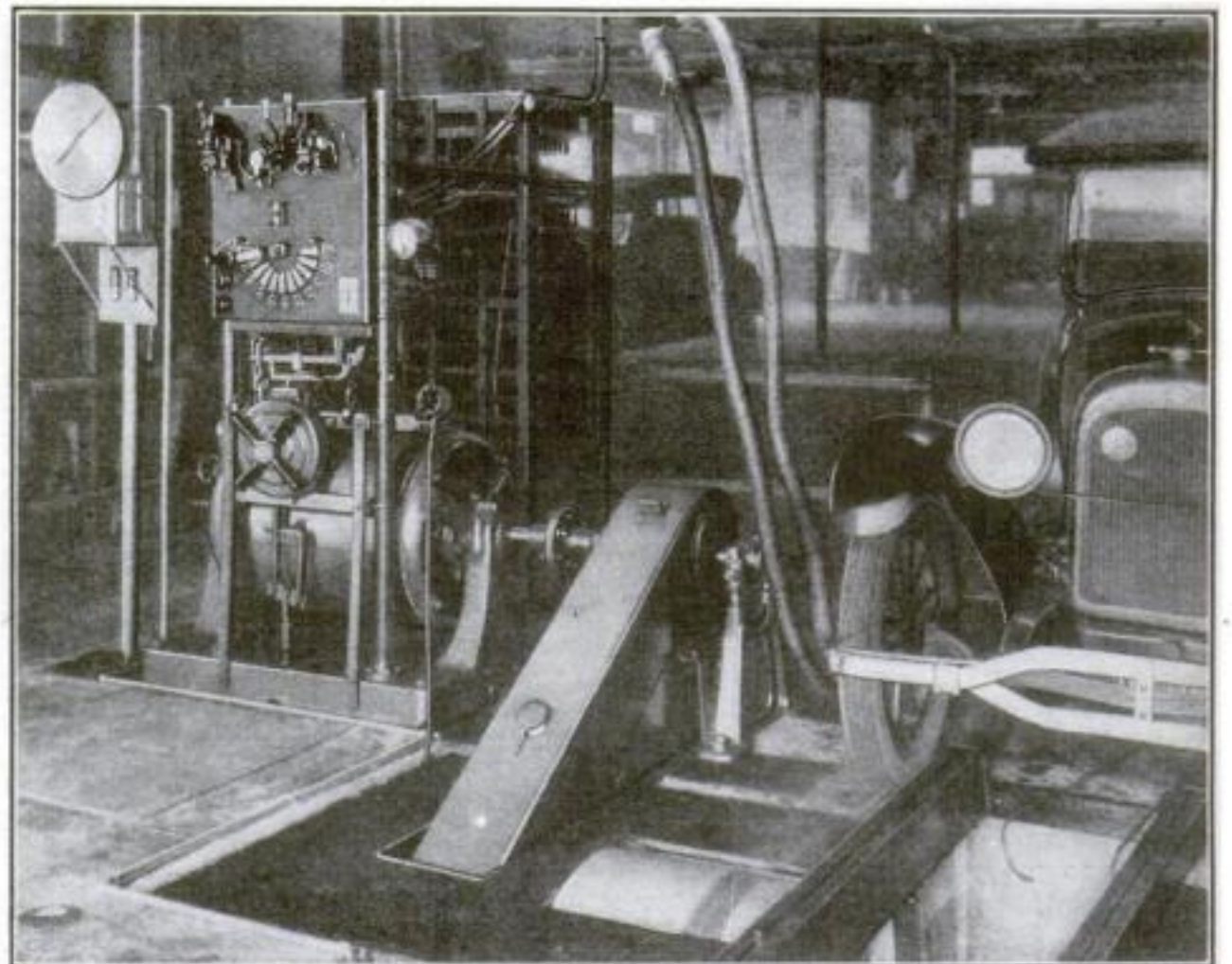
While the horsepower is being tested, gasoline consumption is measured through a flow meter.

By using a process pump inserted in the spark-plug hole of each cylinder, and then pushing and pulling by means of expansion and contraction of air, the condition of pistons, wristpins, and connecting rods is determined and piston slap is located.

ELECTRICAL connections on the generator, starting motor, and battery are checked by connecting them with special meters. Compression in the cylinders is learned by screwing compression meters into the cylinders in place of the spark plugs, then turning over the motor. If gasoline is leaking into the crankcase oil, such leakage is shown when a sample of oil is distilled to determine the exact amount of dilution.

The rear of the car next is jacked up to examine the wheel bearings. The mechanic goes under the car and with a stethoscope listens for undue noise in the transmission and rear axle while the car is "running."

When the test is finished, a detailed report is given the car-owner. This report is used as a prescription for getting whatever repairs may be necessary, after which the "doctor" again sees the car.



Where Autos Are Tested by the "Mechanical Doctor"

The car is driven on a platform so that the driving wheels rest on revolving drums geared to a dynamometer (left). This measures working horsepower and "pull" of the car



In these models based on the recovered bones of prehistoric men of successive ages, science finds evidence of evolution. Left to right: the Java "ape-man," believed to have lived some 500,000 years ago; the Pliocene man, 375,000 years ago; the Neanderthal man, 25,000 to 50,000 years; and the Cro-Magnon man, 20,000 years

Just WHAT Is Evolution?

The Much-Debated Theory of Man's Origin Explained in a Nutshell—Points of Evidence Offered by Science

THE letter on this page from one of our readers arrived in the Editor's mail along with a score of other requests of similar nature. It convinced us that there was a real public need for a clear, concise statement of the subject of evolution, which in recent weeks has aroused bitter controversy and widespread discussion. For that reason we asked the director of POPULAR SCIENCE MONTHLY's Information Department to prepare a reply—one that would tell in terms that everybody could understand, just what the evolution theory is. The reply follows:

DEAR MR. KLINGEUEER:

In the recent deluge of statements about evolution many of them contradictory, some of them misrepresentations, and others colored by passion, it is not surprising that you found it difficult to define the theory. As is often the case, such an over-abundance of explanation and argument has the effect of complicating a subject that actually should be simple.

The simplest and most adequate definition of evolution I have found consists of just two words—"orderly change." The theory of evolution is simply a theory that our world as it is today and all life upon it, have been developed since the beginning of time by slow, orderly processes of change, and that these changes are continuing.

This theory is regarded by present-day scientists as the only adequate scientific explanation of the mysteries of the origin and development of life. It brings to-

gether the collected knowledge of mankind to show that every animal, every plant, and every piece of matter around us has sprung from a few simple forms, changing through the ages usually from the simple to the complex, and toward greater perfection. In fact, it holds that

an instant. It interprets the Biblical story of creation liberally rather than literally.

As to just *how* Nature is believed to carry on her slow processes of evolution—how one form gradually is developed into another; how from a single cell in the sea has come man, the highest and most intricate form of creation—science likewise has its theory supported by study and observation.

Briefly, the most commonly accepted theory, as first propounded by Charles Darwin in the middle of the nineteenth century, may be summarized as follows:

NO TWO individual plants or animals ever are exactly alike. A small variation in one individual may make him better equipped to cope with his surroundings than others of his kind. In the strenuous competition of life, only the individuals best equipped for the struggle for existence survive; the poorly equipped die out. Those that survive pass their useful characteristic down to succeeding generations by heredity. And so through countless generations, by the survival and propagation of the most fit amid different and ever-changing surroundings, in-

dividual variations work to form new species, new families, and new races. So life has progressed slowly from the single cell, through the shellfish, fishes, reptiles, birds, mammals, and finally to man.

This theory of how life has evolved is known as "natural selection." A similar

A READER asks—

THE EDITOR, POPULAR SCIENCE MONTHLY.

Dear Sir: Several of my friends and I discussed evolution the other night. We all felt that as a result of all we had read on the subject during the Scopes trial we knew a great deal about it. But when we got down to brass tacks, no one of us could define the theory of evolution exactly, nor could we state definitely the reasons scientists have for believing in it.

Now you may think it remarkable that a group of so-called intelligent people in this day could be so ignorant, but I have made inquiries and have found a number of others who are in the same boat as ourselves.

I am wondering if you will be so good as to refer me to a book that will answer my needs; or perhaps you could spare the time to write me a letter telling us what we want to know.

Yours very truly,
J. C. KLINGEUEER.

Meadville, Pa.

all life, including man himself, probably developed from a single form—a mere cell.

Thus evolution, as a philosophy of change, is directly opposed to the philosophy of fixed unchangeability. It contradicts the idea of "special creation"—that everything on earth was completed in

process, known as "artificial selection," has been utilized by modern man in the creation of new species of plants and vegetables and in the breeding of horses and cattle. It has been applied to even the rearing of better human families.

In recent years certain aspects of the theory of natural selection have been open to serious question. But while scientists have differed as to the *how* of evolution, they are practically as one in maintaining that the *historical fact* of evolution is supported by increasing and overwhelming evidence. The main points of evidence they submit are these:

1. There are many definite indications that all animals, man included, are akin; that all were evolved from the same ancestor far back in the dim ages. The structure of all animals, including man, follows the same general plan. All have similar organs, such as brain, heart, and lungs, performing similar functions. Man's skeleton can be compared, bone for bone, with that of a horse, a monkey, a seal, or a bat. His limbs have their counterparts in the fins of a fish or the wings of a bird. His muscles correspond with those of other mammals.

This similarity extends also to the senses, emotions, and instincts. Men and the animals have the same five senses and similar sense organs. They show the same emotional reactions, such as fear, jealousy, and anger. They also suffer similar diseases and are affected in much the same way by drugs and stimulants.

The animals that most closely resemble man, and consequently appear to be of closest kinship, are the apes, particularly the orang-outang, the gorilla, and the chimpanzee. Yet scientists never have contended that man is descended from the apes or monkeys. What they do suggest, and what research has tended to substantiate, is their common ancestry, probably in a little tree-dwelling animal resembling the lemur.

2. The history of life on earth as read by geologists in the rocks. Fossils found in successive layers of the earth's crust show that the lowest, simplest forms of life came first. In layers where sediment of ancient sea and lake bottoms were raised by earth upheavals to form land, scientists have read the story of creation. In the very oldest rocks there are no fossils, indicating an age before life began. Above these, in the stratum formed at a later period, are evidences of the beginning of life—the shellfish. Then, in successive layers, each representing formations of countless millions of years, are found the age of fishes, then the age of coal plants and of frogs, then the age of giant cold-blooded reptiles that dominated sea and land, and finally the mammals, the lowest orders first, followed by higher and higher development, until finally man emerges.

In the rocks, too, has been read part of the fascinating development of man. Scientists have discovered bones of at least seven distinct types of primitive men who lived on earth thousands of years

before the dawn of history. The picture on page 25, showing the reconstruction of four of these prehistoric men in the order of the ages in which they lived—the pithecanthropus, or famous "ape-man" of Java, the Piltdown man, the Neanderthal man, and the Cro-Magnon man—illustrates the striking comparative evidence of how man has evolved. Scientists point to the fact that the more ancient the type, the closer the resem-



Man and Horse

The fact that man's skeleton can be compared, bone for bone, with that of other animals, is offered as evidence that all animals, including man, were evolved from the same ancestry. Here is a comparison between the skeletons of man and a prancing horse.

blance to the ape. Measurements and comparisons of skull and brain have convinced them of a definite development from lower to higher intelligence.

3. Corroboration in the life history of the individual. The life history of every man and animal is but a short, spectacular repetition of the story of the evolution of man from the simplest forms, as told in the rocks. The beginning of each one of us is a single cell, which multiplies. Before birth, the human infant resembles in turn a fish, an amphibian, a primitive reptile, a primitive mammal, an ape. At one stage he has gill slits; at another, he has a well-defined tail. Until the last three months before birth he has dark soft hair covering the entire body except the palms of the hands and the soles of the feet. Occasionally a child is born with a primitive tail still external. Only

in its last stages of development does the human embryo differ markedly from that of the ape.

And even after birth the human child still continues to develop in a way that closely parallels the scientific theory regarding the development of the race. As soon as it begins to use its limbs it starts life as a quadruped, and later makes awkward attempts to stand erect. Its language at first is strange noises. Also scientists call attention to the fact that the normal child, when beginning to play, evidences an unmistakable instinct for cave-digging and tree-climbing, and engages in other sports that resemble closely the activities of prehistoric man.

4. Further corroboration in the bodily structure and equipment of man. In the human body we find an amazing number of muscles and organs—nearly 200 of them—which are useless or practically useless to us, but which still serve important functions in lower animal life. These are called "rudiments" or "vestiges"—incomplete parts that have been arrested in development. Such are the muscles for wiggling the ears and those for causing the hair to stand on end. Then there is the vermiform appendix, which not only is useless, but often dangerous. It is believed to be a vestige of a time when our ancestors were grass-eaters; in grass-eating animals this organ plays an important part in digestion.

The scanty, downy hair that covers the human body, the practically worthless molar teeth that come comparatively late in life and decay quickly, the dwindling little toe bereft of one of its joints—these, according to science, are other common rudimentary reminders of our ancestry. And each of us carries about with him the rudimentary bones of a tail! Higher animals, other than man, also carry similar reminders of possible humbler origin. The splint bones in the horse's leg, for example, are explained as vestiges of toes that once were useful when he was a little three-toed animal.

5. New kinds of plants and animals actually are originating and developing today. Continually naturalists are observing how variations in an individual reappear in successive generations. From one kind of plant or animal they see new kinds produced. Within the last 10 years, for example, Thomas H. Morgan of Columbia University says he has observed scores of new forms of fruit fly that never before existed. Similar creations of new species within the span of a few years are reported to have been observed among land snails that live in forests and jungles of many islands of the South Seas.

Another interesting example is the tomato. Not many years ago tomatoes were called "love apples," believed to be poisonous. They were scarcely fit to eat—mostly juice and seeds. Today a dozen luscious varieties of varying shades and sizes have been developed from them. Again, the potato in its first known

(Continued on page 150)

Our Unseen Foes in the Air

How Nature Protects Us Against Millions of Dust Particles that Invade Our Bodies

By Newton Burke

THERE are many queer things in the air we breathe; most of them dangerous, many of them a real menace to life and health. Especially is this true of cities, where factories, hurrying crowds, and rushing vehicles all contribute to the invisible enemies that attack us as we drink in the oxygen essential to life.

These unseen foes, recent scientific research shows, ride on dust particles stirred up by the feet of pedestrians and the wheels of traffic. The average person inhales about 30 cubic inches of air each time he breathes, in which there are likely to be between a half-million and a million particles of dust carrying such dangerous components as—

Germs of many diseases, including tuberculosis.

Garbage, pollen, leaf dust, and other vegetable matter.

Steel and other metal particles from factories, car tracks, and the moving parts of motor vehicles.

Soot and dust from factory smokestacks.

Insect eggs and fragments of insect bodies.

Poison gases from industrial furnaces and, probably the deadliest menace of all, carbon monoxide from the exhaust pipes of motor vehicles.

The only reason we can withstand the ravages of our unseen enemies of the air is that we have been provided with a marvelous mechanism for repelling their attacks. Most of the germs in the air do

us no harm because they are dried out. This is true of germs of typhoid, diphtheria, and tuberculosis. Moreover, no germ, even if harmful, can injure us until it gets into the blood, and formidable barriers have been set up to prevent this. The mucous membrane in the nose and throat trap solid particles such as steel slivers, sand, and soot. Thousands of delicate hairs in the lining of the windpipe and bronchial tubes catch stray particles, while at the root of the lungs are lymph filters.

Particles and germs getting beyond these first lines find waiting a powerful army of about 35 billion red corpuscles in the body, each capable of choosing what it will deliver to the body cells and what it will dump as garbage.

Then, swarming in the blood are phagocytes, hollow cells that devour microbes. Finally come the leucocytes, white cells that destroy harmful bacteria and waste material. A disease germ has little chance against this formidable array.

Science now is turning its attention



Sanitary inspectors taking samples of air from New York City streets to determine the actual danger to human beings from carbon-monoxide gas discharged from thousands of motor-cars

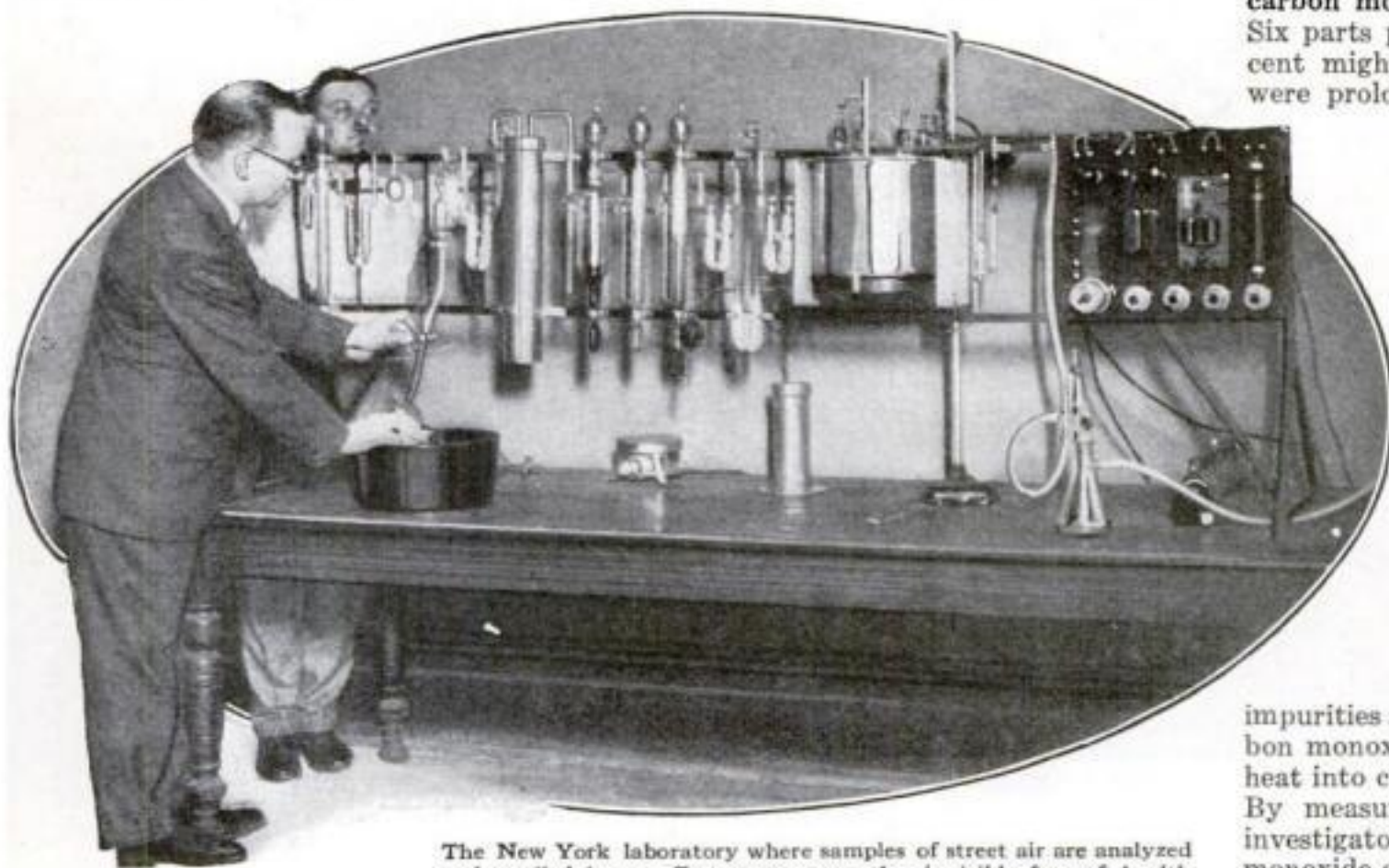
to the gases; for evidently nature did not foresee automobiles and provided no safeguards against carbon monoxide poison they produce. This poison is admitted into the blood as readily as oxygen. Slightly more than a quart of carbon monoxide is enough to kill a person, and the average automobile, according to tests made recently by the United States Bureau of Mines, produces up to two cubic feet of it a minute.

A man can just tolerate four parts of carbon monoxide in 10,000 parts of air. Six parts produce headache, and one per cent might cause death if the exposure were prolonged. Vapors from an automobile exhaust sometimes contain as much as 10 per cent carbon monoxide.

New York City recently began an investigation to determine just how dangerous carbon monoxide on city streets is to public health. With oddly shaped glass tubes and a small suction pump, scientists have taken samples of air from street corners where traffic is greatest.

These samples are passed through an apparatus that separates the air into its various parts.

Various chemicals absorb impurities and gases until finally only carbon monoxide is left. This is changed by heat into carbon dioxide and free iodine. By measuring the iodine liberated, the investigators can tell the quantity of monoxide originally in the air.

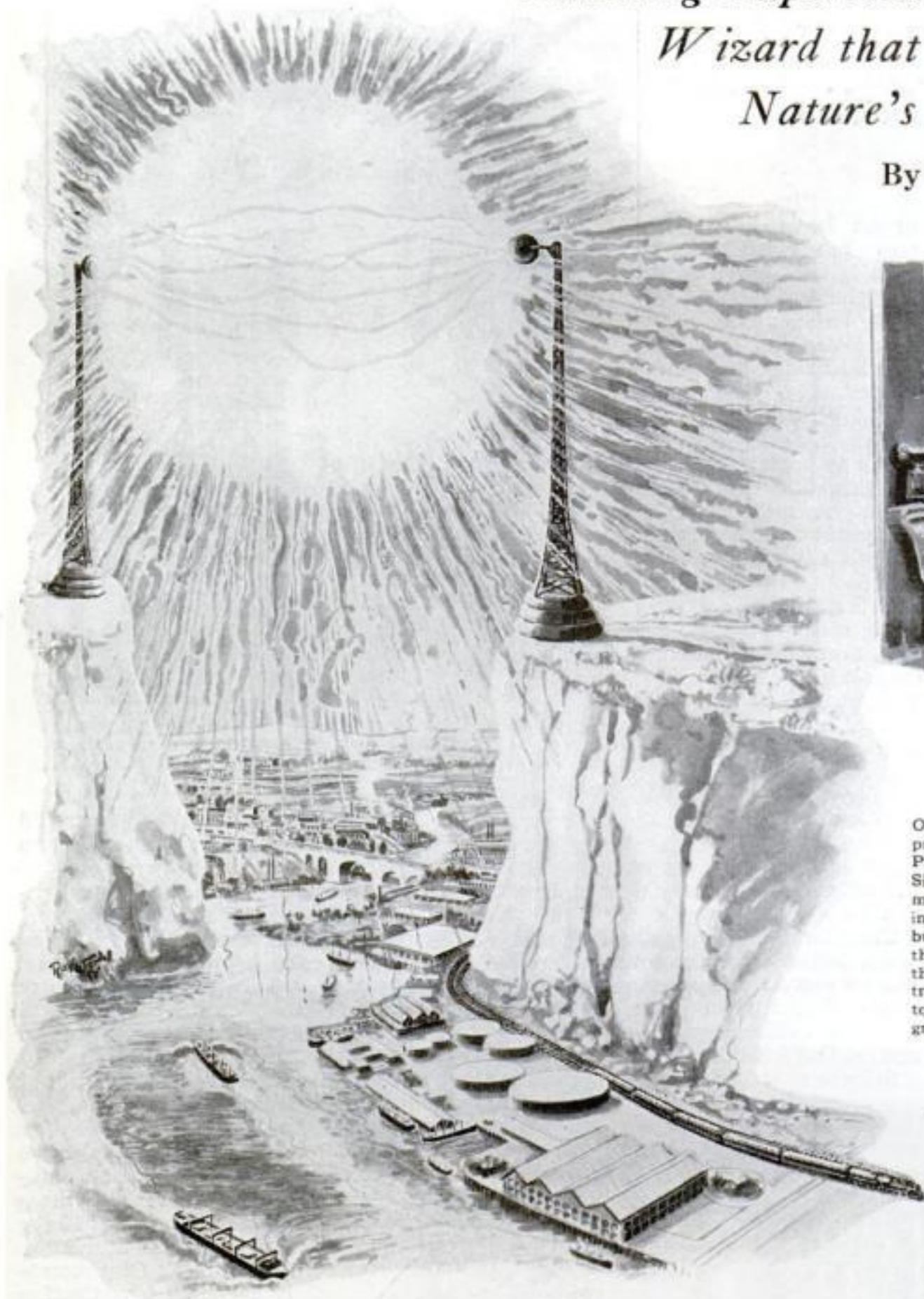


The New York laboratory where samples of street air are analyzed and studied in an effort to conquer the invisible foes of health

Can Man Reproduce the Sun?

Dazzling Experiments Convince French Wizard that Science May Rival Nature's Vast Power Supply

By Frederic M. Delano



How Man-Made Sun May Appear

Our artist has pictured here the possible sun-producing plant of the future, as prophesied by Prof. Jean Perrin, famous French electrical wizard. Simply by throwing a switch, the operator releases millions of volts of direct current. Between towering giant electrodes there leaps a blinding bolt that builds up into a mighty orb of incandescent fire as the electric current blasts atomic structure. Some of the vast energy released and captured would be transmitted in the form of electricity to run factories and trains or to provide light and heat for great communities, in place of coal and oil

world of science and practical research.

"But, Professor Perrin," I questioned, my eyes still dazzled by that blinding flash, "is what you say to be taken literally—do you actually hope to produce an artificial sun?"

"On a small scale—yes," he replied calmly. "What you have just seen is the beginning of the process. When I have a machine of sufficient power, I can complete it. For with 10,000,000 volts of direct-current electricity, I believe I can break up the atomic structure of matter—disintegrate individual atoms; perhaps even drive the nucleus of one atom into another atom and thus create a much denser atom. If I am able to do that, the secret of the sun's radiation will have been solved.

"I BELIEVE," he continued, "that the sun is formed by the constant changing of the extremely light atoms of hydrogen into atoms of greater density, such as atoms of oxygen, nitrogen, and the other heavier elements. According to my theory—and many other scientists agree with that theory—everything in the universe—the sun, the stars, the planets, and everything on them—once consisted

LEAPING across the gap between the electrodes of a giant electric machine, the mighty arc of blue-white flame dazzled my eyes with its awful intensity. A terrific crackling roar smote the quiet of the laboratory. My senses reeled before this revelation of almost unimaginable power.

Professor Jean Perrin, white-haired, white-bearded, benevolent-faced, opened a switch with a long-fingered white hand. The dazzling glare was snuffed out. The crackling ceased. In the sudden quiet even his low-pitched, pleasant voice sounded loud.

"It is but the beginning," he said. "Soon I shall have available a means of producing 10,000,000 volts of direct-current electricity. Then, perhaps, I shall

be able to reproduce, on a small scale, the conditions that cause the radiation of light and heat from the sun and the still more gigantic stars of the universe!"

I gazed at him in amazement, scarcely comprehending the significance of his words.

Was this man actually voicing the hope that he might rival Nature itself? Usurp the power that drives the universe?

It seemed incredible. And yet, I recalled, it was no crack-brained zealot talking, but a noted scientist, whose opinions are respected by scientists the world over. Head of the laboratory of physical chemistry of the famous University of Paris, member of the French Institute—it would be difficult to find another who occupies a more stable position in the

of atoms of hydrogen, and these have changed gradually into heavier atoms that make up our atmosphere, our soil, our rocks, our own bodies.

"Nearly all scientists now agree that atoms themselves are composed of positive nuclei and negative electrons. Each positive nucleus and the negative electrons that rotate around it form, it is believed, an infinitesimally small solar system; so small, in fact, that billions of these complete solar systems in miniature are required to make up the visible material that composes the point of an ordinary pin, for instance.

ATOMS, of course, are so exceedingly minute that it is almost impossible for us to conceive a satisfactory picture of them. The number of atoms of oxygen and hydrogen in an ordinary pail of water undoubtedly exceeds the number of grains of sand that would be contained in a beach 50 feet wide, encircling the entire continent of Europe.

"It is difficult, too, to form in our minds a definite picture of the structure of the atom. For example, scientists believe that if an atom were as large as the city of Paris, the nucleus would be about the size of a block of houses, while each electron, whirling about at a rate between 2000 and 93,000 miles a second, would be approximately as large as a taxicab.

"Now the only difference between various kinds of material, such as air or wood or steel, lies in the numbers of electrons that revolve about each of the nuclei that make up the material.

"In changing into any other element, I believe that hydrogen changes first into helium, which, you will recall, was found in the sun before it was found on earth. In doing so, a portion of its atomic weight is lost, and given off as energy. This released energy comes to us from the sun in the form of light and heat, and makes life possible on the earth.

"How did this process of constant change get started? Probably the collision of two or more hydrogen atoms, or groups of atoms, produced the first energy. As a little match will set fire to a great forest, so this collision set going the con-



He Hopes to Blast the Atom

Prof. Jean Perrin, head of the physical chemistry laboratory of the famous University of Paris, who says that soon he will have the means of producing 10,000,000 volts of direct-current electricity. With this he expects to reproduce on a small scale the conditions that cause radiation of light and heat from the sun

stant reaction that, by always creating heavier atoms from those of minimum density, produces the sun's heat.

"By hurling against the atomic structure 10,000,000 volts of electricity, I may be able to produce this change of light atoms into heavier atoms, and thus, in effect, create another sun."

I recalled to Professor Perrin that the late Doctor Steinmetz and his co-workers in America already had produced in the laboratory thunderbolts of a million and two million volts.

THAT is quite true," Professor Perrin explained. "But he was working along different lines and he used alternating current. To break up the atom, one must have direct current so that a definite potential, either positive or negative, can be applied to the atoms you are trying to disintegrate.

"Hitherto the greatest direct-current voltage obtainable was between 250,000 and 300,000. My machine, however, delivers almost 600,000 volts. Greater direct-current generators undoubtedly will

be built. Eventually we shall have one capable of producing 10,000,000 volts. Then we can proceed with our work."

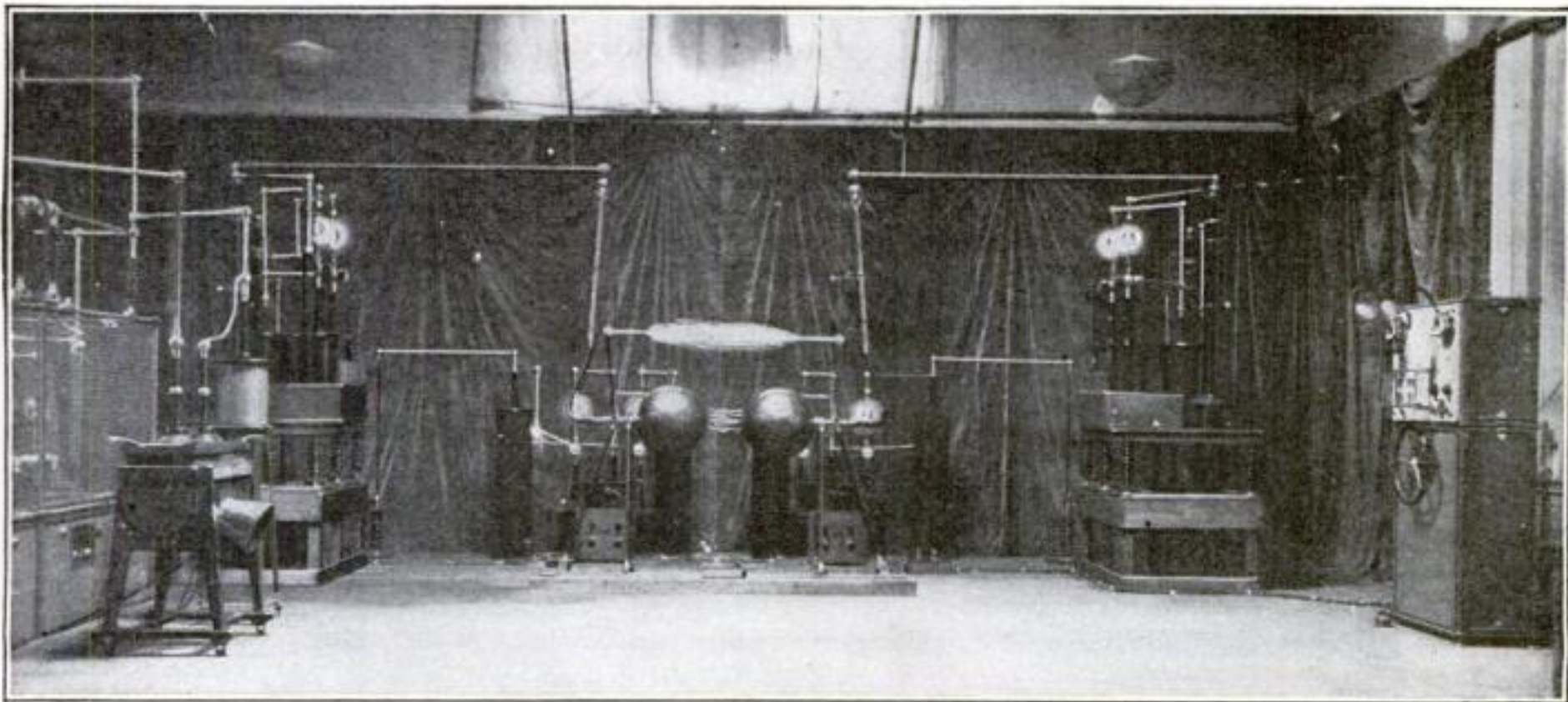
I pondered over what he had told me, and immediately the thought occurred—suppose he succeeded in accomplishing his astounding plan. What would that mean to our world? If the series of atomic changes he described had spread like wildfire on the sun, how could we know that the same thing would not happen on earth were man to reproduce artificially the conditions that created the sun? Would it not break up the entire atomic structure of the universe? Would it not cause our world to burst into flames and burn us all into cinders in the twinkling of an eye?

I ASKED Professor Perrin these questions. He replied with a Gallic shrug of his shoulders. "Disaster," he admitted in his quiet voice, "is a possible consequence of smashing an atom. But it is the duty of the true scientist to investigate all phenomena. It is only in that way that we may learn. We must not be afraid."

Then a smile curved the lips of the white-bearded scientist. "But disaster is highly improbable," he added, "and the possibility of disaster is outweighed by the tremendously useful possibilities contained in the process I have in mind. Consider: Our civilization is built on machinery; that would be useless without power to run it. Our supplies of coal and oil will not last forever. There is only a limited quantity in the earth and when that is exhausted by future generations, there can be but one result—stagnation, starvation, disaster—unless before our supplies of natural fuels are exhausted, science finds some new source of power and learns how to use it. Perhaps it will be the power generated by the disintegration of atoms that will make possible the saving of our civilization from annihilation."

And then Professor Perrin outlined for me a vivid, convincing picture of the tremendous power-producing plant of the future—the plant in which scientists may

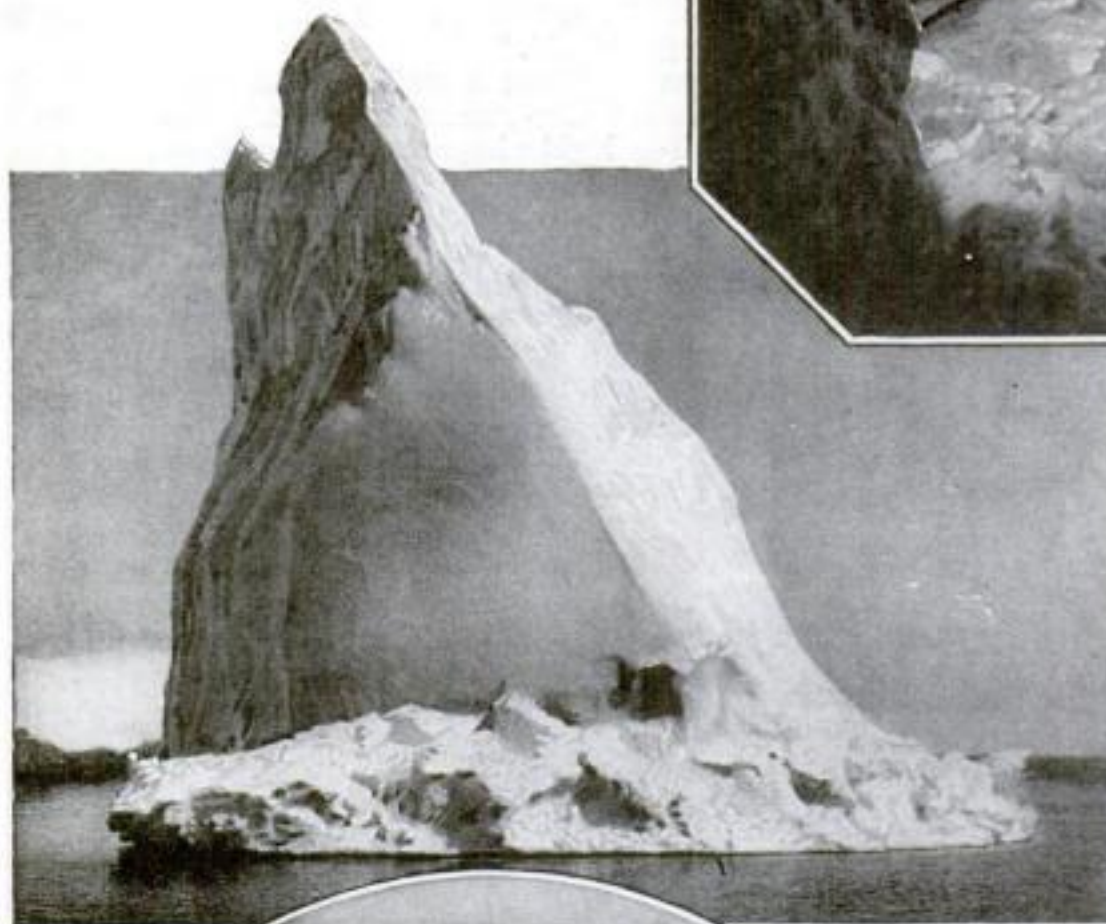
(Continued on page 152)



Professor Perrin's new 600,000-volt direct-current machine in Paris, with which he is conducting experiments that he hopes will lead to the disintegration of the atom. Hitherto the greatest direct-current voltage obtainable was between 250,000 and 300,000 volts

An Ice-Locked Island of Mystery

THE gleaming beauties of a strange barren island of eternal ice that lies in the Antarctic Ocean south of Cape Horn are revealed to the world for the first time in these remarkable photographs recently taken by Captain Frank Hurley, famous explorer and photographer. The land is called "Elephant Island," and it is one of 12 islands in the South Shetland group that are entirely devoid of vegetation. Here Captain Hurley and party spent eight months of exploration



A Land of Gleaming White

Mountains, forests, ravines, and caverns, all carved by nature in perpetual ice, make Elephant Island a place of fascinating mystery. Members of Hurley's exploration party are seen above digging a tunnel leading to a vast ice cave. At the left is an iceberg towering in the form of a giant helmet off the shore of the island



In the frozen wilderness. At the left one of the explorers is seen making his way through the ice forests of the island. The picture at the right shows another member of the party looking into a deep abyss from a cliff of one of the mountains of ice

"YOUR success or failure in a new job often depends on the questions you ask in advance about the men and the concern you are to work for."



Municipal employment bureau in New York City, where men usually ask only about hours and pay

How to Pick a New Boss

Secrets of Getting the Right Start Revealed by Science

By Samuel S. Board

AT THE head of one of the greatest dry-goods organizations in New York is a man who attributes his success largely to the fact that he once turned down a \$25,000-a-year job in favor of one paying \$5000!

The reason for his astonishing decision was his deep-founded conviction that care in choosing the right kind of boss and the right kind of concern is the most important factor in business success—much more important than immediate financial return.

In the case of the \$5000 job, this man knew the employers to be men of character and ability—men he would like to work for. Of the \$25,000 job he was not so sure. On one hand he saw certain opportunity, steady advancement from a comparatively small beginning; on the other, in spite of the immediate reward, the future was at least doubtful. One position offered a chance for active interest in the business; the other was just "a job."

Look at the records of men who have attained business success and you will find, I believe, that, in almost every case, at every step along the way, they have studied carefully every prospective job, and have chosen deliberately the bosses they will work for!

In recent years scientific methods have been used more and more in reducing business inefficiency. Nowhere has the effect of these methods been more marked than in the selecting of men for jobs. Nearly every one who has applied for a job with a big corporation has met this effort in the form of an "application."

MR. BOARD is a leading authority on the new science of job-getting, known as vocational guidance. The advice he gives here is based on his actual experience as Vocational Director of the Central Branch, Young Men's Christian Association, Brooklyn, N. Y., where he has aided hundreds of men to fit themselves to the right job.—THE EDITOR.

And just as it is important for the employer to know what kind of man he is hiring, so it is as important, or even more so, for the employee to know certain definite facts about the men and the concern he is to work for. Success or failure may hang on that knowledge.

Most employers whose salesmen handle money demand a bond. Yet I know of more than one good salesman who has tied up with a concern, risking both his good name and his trade repute, without anything but a perfunctory inquiry as to the firm's financial reliability. And when it has gone bankrupt in two or three months, he never has blamed himself.

A typical example of the really tragic results that often come from this lack of scientific care in job-getting recently came to my notice. A young office manager with good prospects in a New York wholesale house decided that the field in which he worked was restricted. He answered a Chicago firm's advertisement. After a few perfunctory inquiries he

agreed to go to Chicago. Upon reporting for work, he discovered that not only was his immediate superior "a crotchety old maid," but also that the firm was shaky financially. When the company went on the rocks a few months later, more than one of his acquaintances said, "Why, if only you had asked me, I could have told you they were on the toboggan. I supposed you knew when you took the chance." Simply because he failed to ask a few vital questions about his employers, he found himself out of a job at the worst possible time of year.

The average man, particularly the young man, doesn't ask very many questions when he is interviewing a prospective employer. He usually just sits and listens, although he can be depended on ordinarily to find out what the pay is, what the hours are, what department he is to work in, the name of his job (if it has one), and when he will start to work if hired.

THERE are, however, other items just as essential if less obvious. In fact, it is just as possible for you to use an application in picking a new boss as it is for an employer to use an application when he is hiring you.

Of course, you can't go to Mr. Smith of Smith and Jones, and say, "Now, Mr. Smith, here's an application for my services that I should like to have you fill out, and if it is satisfactory, I'll interview you in a few minutes." But there are certain essential facts you can seek every time you apply for work. You can jot them down on paper before you interview

an employer, and then make a conscious effort to obtain the information from him.

Is the position permanent or temporary? What are the qualifications for the job? Under whom will you work? In what surroundings? To what higher position would the job under consideration lead? These are a few of the vital points any reasonable employer should be willing to make plain. Others I have embodied in the typical "application" that accompanies this article. Many of these questions may seem obvious, yet it is surprising how often they are forgotten in the excitement of getting a job.

IT WAS only last June that an enterprising young man obtained a bookkeeper's job at a summer hotel. Everything looked fine until he discovered that the proprietors were Austrians, most of the employees were Germans, as were many of the patrons. Knowing nothing of the German language, he was decidedly out of place and could not give efficient service. A few careful inquiries before he made the move would have saved him time, trouble, and expense, as well as disappointment.

Men who have spent years in specialized training and reputation building should study prospective positions very carefully. They must consider such questions as the general standing and prospects of the industry or occupation, the financial and business standing of the firm, the type of person with whom they will have to do business, both inside and outside of the organization, why the last incumbent of the position left, and whether the demands of the work are within their limits, whether these limits be physical, mental, or social.

LAST winter a man who had spent several years studying accountancy, and who had been getting about \$3000 a year, confident of his training and ability, came to New York from the South. After some search he took a job with a public accounting firm with the understanding that, while no definite sum was settled, he would be paid a salary corresponding to the work, and would find a permanent berth.

When his first weekly pay check came it was \$27! He protested, but his protests brought only promises, though he was given work for which other firms were paying \$50 and \$60 a week. It took him more than three months to find a job elsewhere at a figure near his former salary, and then he stepped out of the first organization just before most of the employees were laid off. The firm only wanted his services for the three or four months in question. They had a reputation for "stringing employees along." But the Southerner had neglected to make the inquiries necessary to reveal this and he had neglected to pin

Facts You Ought to Know about the Job

IN THE following questionnaire Mr. Board has listed what he says are the essential facts to be sought whenever you apply for a new job. The best way, he says, is to study them before you interview an employer, and then make a conscious effort to obtain the information from him:

Exact name of firm or employer
 Address Phone
 Business (part of what industry or business)
 Duties Pay How paid
 Training and education required and desirable
 Relationship to rest of organization
 Work starts Temporary or permanent
 Name and characteristics of immediate superior
 Hours Health conditions
 Type of associates
 Name and position of interviewer
 Policies and methods of hiring, firing, and promotion, including raises.
 Are they done through—
 1. Employment department?
 2. Department heads or head of firm?
 a. Merit
 b. Connections
 c. Seniority
 Status of industry as a whole
 Status and reputation of this firm in industry
 Financial status
 Requirements for further progress in work:
 1. Education
 2. Personal development
 3. Experience in the organization

his employers down to a definite salary and a definite opportunity for advancement.

Firms with reputations for fairness are particularly careful to have such conditions frankly stated.

Employee and employer alike commonly fail to consider the physical limitations of a job. A young man of excellent personality and real ability came in to see me the other day, jubilant over an opportunity with a well known ribbon house where advancement was almost certain. Yet a vocational interview showed that the young man was afflicted with a special form of color blindness, and that a ribbon house in which he would have to match the most delicate variations of color was the last place in which he could work effectively.

This Way Is
a Gamble



Answering an "ad" and jumping into a job without first finding out the status of the employer and what the job holds for you is likely to result only in disappointment and considerable loss of your time and effort

He had not thought of this handicap, if he knew about it, and the employer had not tried him out.

WHILE in many large companies a physical examination is a part of the process involved in getting a job, such examinations usually are conducted only to determine the likelihood of the company's liability for damages in case of accident, or to meet requirements of compensation insurance policies. Seldom is an effort made to study the probable effect of the job on a man's health, and almost never is the subject considered from the standpoint of future jobs the applicant may be in line for.

Here the question of your future is clearly up to you when you apply for a job. If you would carefully build your career according to a well-arranged scientific plan, it is essential at the outset to find out what your future jobs are likely to be, and what they will demand in health, education, and social abilities.

Almost every position has some drawbacks, yet if you know the facts and study them carefully and methodically,

you will be surprised how they will help you avoid pitfalls that almost inevitably confront a man in a new job. A friend of mine recently succeeded a brilliant man. At a luncheon he was introduced by his new chief to other members of the staff with the invitation to "say a few words." It so happened that just before the luncheon one of the men had whispered to him that he should not, under any circumstances, make a speech. So he turned the invitation off with a remark about actions speaking louder than words. Later it developed that his predecessor had antagonized his associates frequently by lecturing them as if they knew little and he knew it all. Thus, any similar tendency on his part might have hampered his work materially.

Such seemingly unimportant facts as the personality of a predecessor are of utmost value. The more we can learn in advance about the character of prospective employers and associates, the better we can determine our chance to fit into the scheme successfully.

INFORMATION about the standing of the business as a whole and of one firm in particular sometimes is difficult to obtain, but there are trade and technical publications that give summaries of general industrial conditions and the prospects for the future. The ratings given by Dun and Bradstreet may not be available for use directly, but unless the firm you seek information about happens to be a client of your bank, the bank usually will be willing to give you a fairly definite idea of its standing. Then too, nearly every man has friends to

(Continued on page 170)

U. S. Army Tests "Flivver Cavalry"

Light Bullet-Proof Car Designed for Speedy Cross-Country Scouting

INSTEAD of thrilling charges of cavalry, will future warfare see squadrons of troopers careening over rough ground in automobiles?

The U. S. Field Artillery Board recently tested a cross-country car, the vehicle that may replace the horse in battle, at the Aberdeen Proving Grounds in Maryland. After the trials the Board recommended the adoption of the car for field artillery reconnaissance, finding it superior to caterpillar-tread tractors and to motorcycles for cross-country work.

The vehicle, as designed for the Maryland tests, is a stripped Ford chassis with bucket seats, built on. It is equipped with balloon tires. An auxiliary transmission permits the low speed of three miles an hour, necessary to accompany marching infantry. The radiator and engine are protected by a bullet-proof shield.

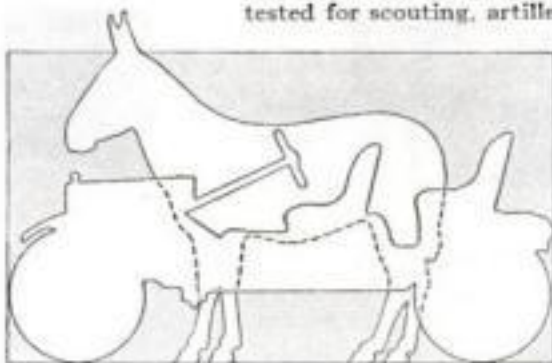
A new transmission was added to the regular system, giving two neutrals, six speeds ahead, and three to the rear. Two stabilizers keep the body from bouncing on rough roads or across country.

For scouting work the little car has the advantages of greater speed and less vulnerability than horse or mule. Hits on any part of the bodies of animals, excepting the ears and tail, disable them; the car offers far less of a target and a far more resistant one. Poison gas is fatal to animals, but does not affect the internal mechanism of a motor-car.



The Cross-Country Scout Car

Giving from 15 to 20 miles to a gallon of gasoline, this little car is being tested for scouting, artillery, and motor transport work in U. S. Army



Which Makes Better Target?

The diagram above demonstrates the greater vulnerability of a mule to enemy bullets and shells as contrasted with the bullet-proof car

A horse or mule takes three years to grow, while the cars may be turned out at the rate of 6000 a day. If a horse or mule loses a leg, it is out of service for good, but a wheel or other damaged part of an

automobile may be replaced within half an hour. Also, an animal must rest, while from the motor-car 24-hour service is obtainable.

The new adjunct to the army's mobility is not only a sort of flivver cavalry; it might be called also "flivver field artillery," for its purpose is to replace the individually mounted men of motorized units, such as our tractor-drawn ordnance, and to carry out that general reconnaissance work that all guns require for selection of position and observation points. It is a unit of the motor transport, too—a unique cross-country branch of it. For that service it has a carrying capacity of 500 pounds.

A final report will be made as soon as a test car has traveled 10,000 miles.

Fitting the Last Girder for Greatest Suspension Bridge

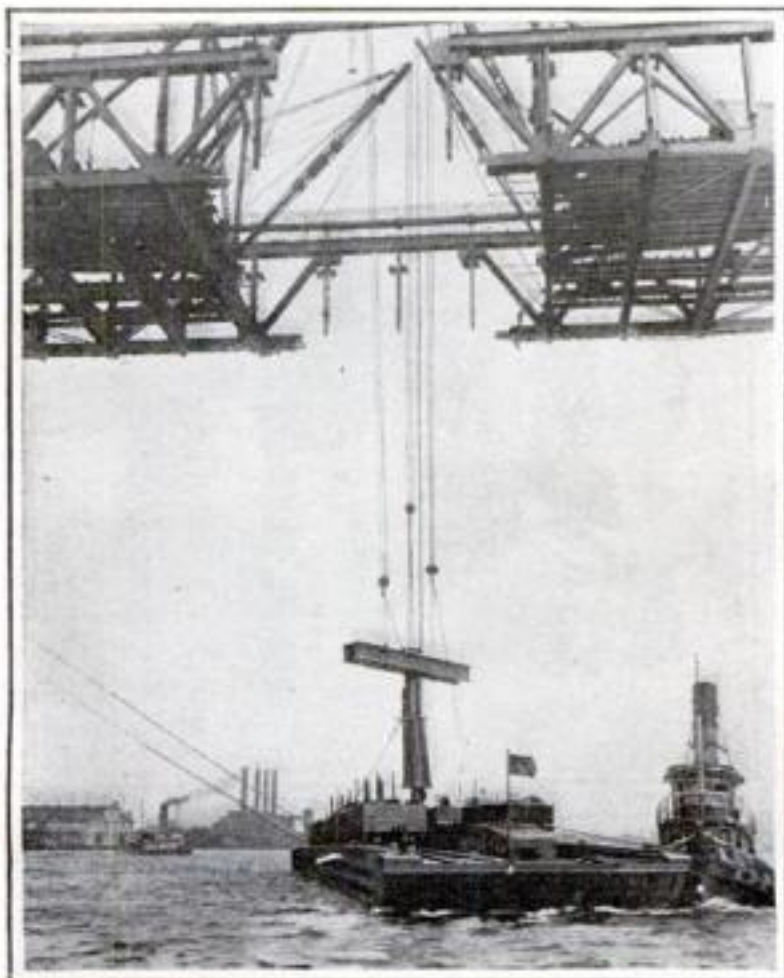
THE unusual photographs below show how the last and largest girder was hoisted into its place in

the central span of the world's greatest suspension bridge, which is nearing completion across the Delaware River between Philadelphia, Pa., and Camden, N. J. The great piece of steel was swung up from the deck of a lighter below and quickly fastened in place in the center of the span.

The Philadelphia-Camden bridge has the longest clear center span ever suspended. The total length between

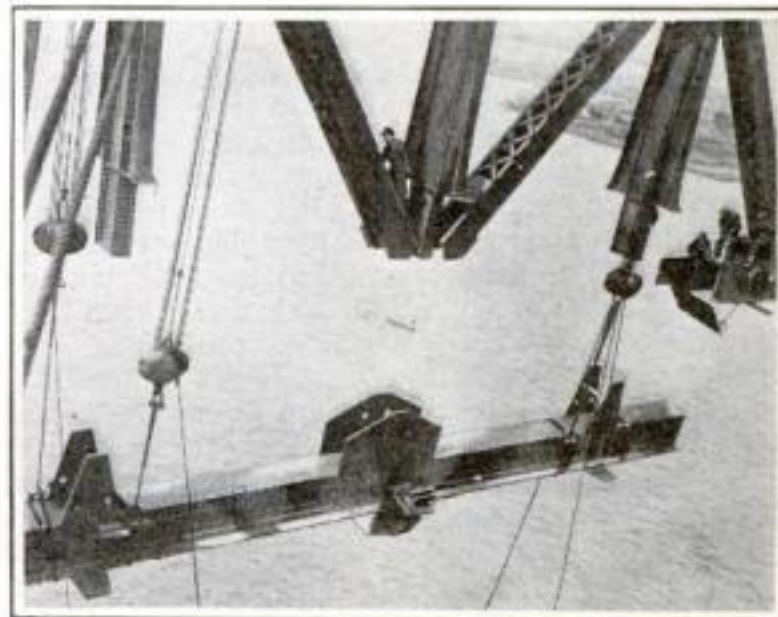
piers is 1750 feet—118 feet longer than that of the new Bear Mountain-Hudson River bridge, and 150 feet longer than that of the Williamsburg Bridge across the East River in New York City.

From end to end the Delaware River bridge is 9600 feet long, and from anchorage to anchorage, 3536 feet. Its huge suspension cables are made of thousands of tallow-dipped steel wires. Construction work has been under the direction of Ralph Modjeski, famous bridge engineer.

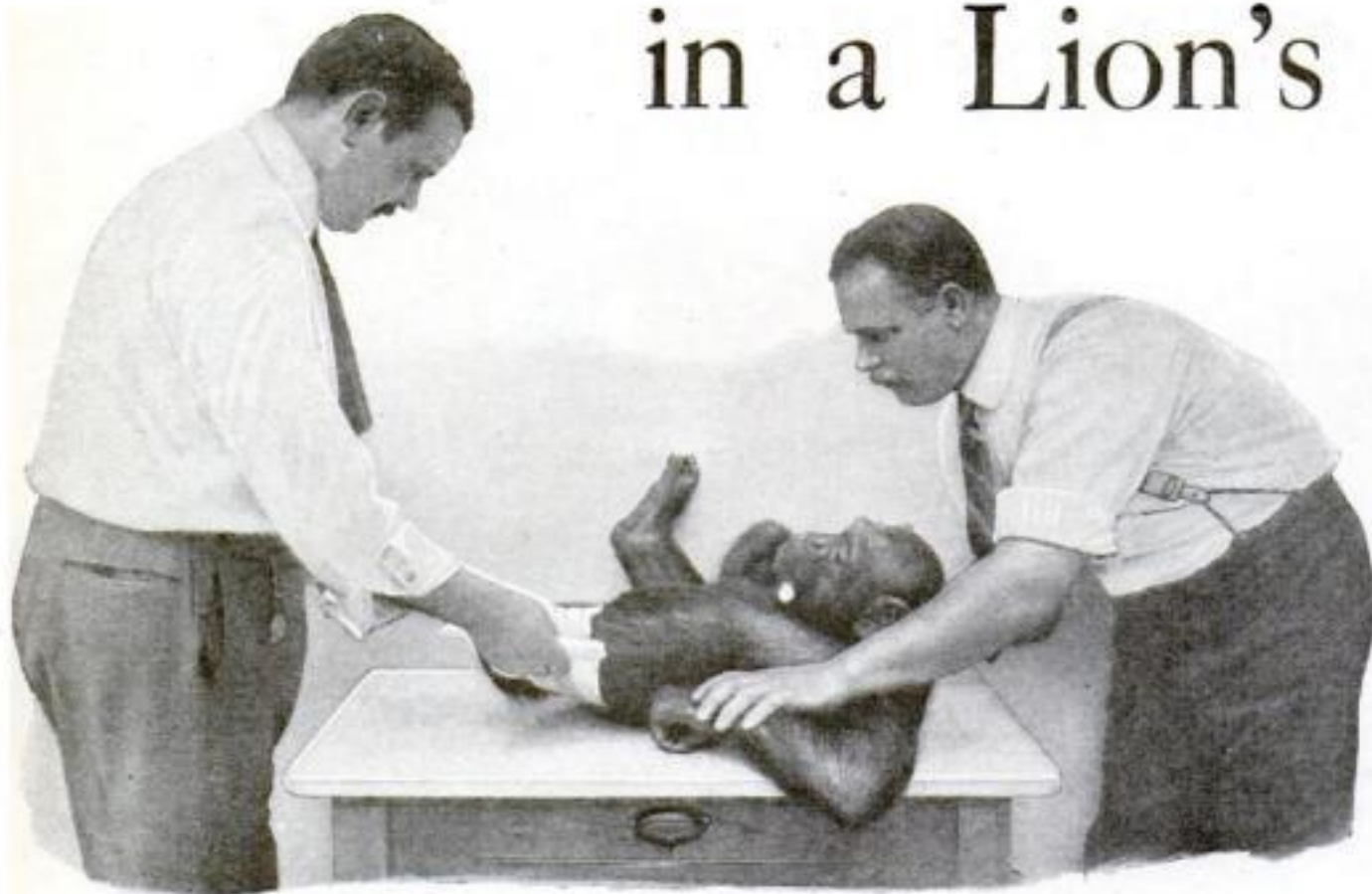


Closing Up the Great Span

The picture at the left shows the last girder of the Philadelphia-Camden bridge being lifted from the lighter below. At right: Workmen standing ready to guide the girder into place and thus complete the great span of 1750 feet, which is the longest suspended span in the entire world



Would You Poke Your Fingers in a Lion's Mouth?



A Hospital Case from the Monkey House

Monkeys make satisfactory patients; some even seeming to enjoy the attention they get when in the hospital. Doctor Blair is shown above dressing a broken leg of an ape.

HOW would you like to stick your fingers in a lion's mouth when the proud king of the jungle is convulsed with pain and rage from an abscessed tooth? And how would you like to force food down the throat of a surly boa constrictor whose appetite isn't what it ought to be?

Doctor W. Reid Blair, organizer and director of the Medical Department of the New York Zoological Garden, doesn't think anything of it. He's performed more than 1500 operations on wild animals during the last quarter of a century. He says he takes every necessary precaution and, pointing to a bottle of chloroform, that he takes no chances.

YET, Doctor Blair will tell you of the time he removed a wire that had become lodged in the hide of a buffalo, and how the crazed beast, freed of its ropes and lariats, gave a wild snort and made for him. He took that fence in nothing flat, the ungrateful buffalo thundering and bellowing a step behind.

Then there was the time when Doctor Blair operated on the infected foot of a prejevalski, which, if you don't happen to know, is a wild horse from Central Asia. Just as the delicate part of the operation was concluded, the animal gave one perfectly healthy kick and Doctor Blair flew through space, landing (happily for him) on a bale of hay.

It would be a ticklish job if anything ever happened to Khartoom, the Zoo's prize African elephant. This valuable beast is so vicious now that he never can be approached, and if he happened to get sick or break his leg or otherwise hurt himself, he would have to be shot. Khartoom would kill any man he could reach. He is 23 years old and stands well over 11 feet in height. And he will probably live to be 60. He has two cages,

with a great connecting door, so that he can be kept clean and free without being approached.

Popular fancy considers an elephant as husky and tough as his hide, impervious to bullets and quite immune to ordinary ills. Yet, curiously, the skin of an elephant isn't tough at all. It may resist rifle fire, but it succumbs to bacteria. Elephants have to be carefully watched, for they suffer frequently from eczema.

Elephants are subject to brain lapses, too, despite the fact that they are clever, patient, and willing. And that makes trouble for the doctors. Imagine a great big elephant tripping on a sloping runway, falling just two feet, and fracturing his thighbone. That preposterous accident happened at the Bronx Zoo a few years ago, and even Doctor Blair couldn't save the beast, worth \$4000. He had to be killed.

Bears also need plenty of surgical attention. They are fighting constantly with each other and tumbling around on rocks and in pits. Recently a huge Alaska brown bear, in a vicious fight, drove one of his canine teeth (two inches long) through his upper lip. The animal was wild with pain and anger, and Doctor Blair and his assistants had to catch him, chloroform him, pull his lip down by strenuous traction, and then treat the wound.

ONE of Doctor Blair's most extraordinary operations was on a bear. A grizzly got a lumpy jaw, a growth something like that common to range cattle. The bear was in severe anguish and had to be coaxed

The Vivid Story of a Doctor Who Does and Lives to Tell of His 1500 Operations on Wild Beasts

By Robert E. Martin

into a hospital cage to be chloroformed. Early in his work, Doctor Blair found that wild animals will respond to anesthetics more quickly when they are indoors. The difficult operation on the bear's jaw was successfully performed.

An African two-horned rhinoceros with a badly swollen cheek was found by Doctor Blair to be suffering from necrosis of the lower jawbone, caused by a decayed tooth. The animal was put to sleep (though the task was dangerous and one of his nostrils had to be stuffed to do it) and the bone was scraped.

A LION whose mouth kept him in agony was treated by Doctor Blair without an anesthetic. This beast had caught a bone in a molar tooth and was in a frenzy trying to dislodge the impediment with his clumsy paws. Doctor Blair got the lion to the front of his cage and managed to insert a pair of tongs in



Elephant Wears Surgical Boots

A little Congo elephant at the Bronx Zoo had the misfortune to fracture one of his hind feet. Treating the fracture was part of Doctor Blair's usual routine, but designing the pair of surgical boots was a noteworthy accomplishment and speeded the animal's recovery.

his open mouth. The lion fought and battled, beside himself—until Doctor Blair managed to get the tongs on the bone. The beast suddenly seemed to sense that here was a Samaritan, a benefactor who would allay his distress, and he kept quiet for a moment. Doctor Blair yanked. The bone came out. And the lion lay down and yawned, as though nothing out of the ordinary had happened.

"IT WOULD make a charming commentary on our work," Doctor Blair told me, "if we noticed appreciation on the part of our charges for what we do for them. As a matter of fact, we don't see any response. Most of the animals protest loudly and vehemently. The monkeys act up something awful. The lions are very obstreperous."

It is true that an animal once treated submits to medical and surgical attention more easily afterward. There was an orang-outang who was a champion hospital addict. He was constantly looking for attention and was very agreeable about it.

The most unusual operation ever performed by Doctor Blair was on a great elk, an Altai wapiti or Asiatic elk, which had been in a terrific fight with another of his tribe. This animal had been gored so frightfully that 16 inches of intestines protruded from its side. By any ordinary standard, the animal should have been killed instantly, but Doctor Blair caught him, had him crated, washed the intestines, put them back in place, stitched the side with 14 interrupted stitches, and bandaged the wound. Daily dressings soon brought the wounded warrior back to health.

ONE of the most difficult operations performed by Doctor Blair was on a regal lioness, captured by the famous Buffalo Jones in Africa. When the animal arrived at the Zoo, it was noticed she was surly and resentful. She would not



Forcible Feeding as Practised at the Zoo

When a snake is ill, it will not eat, and the keepers feed it, stuffing the food down to the snake's stomach, which in this instance was 5½ feet from its mouth

eat except at night, under cover of darkness. She sulked and would not permit an inspection.

Finally, after close observation, tiny drops of blood were noticed on the floor of her cage and it was deduced that her claws must have grown into the pads of her feet. Her nails had to be destroyed. But getting this proud lioness to an operating table was a real task, a problem for true ingenuity.

Now, the lion-house at the Bronx Zoo is very well equipped, and one of its modern improvements is an elevator, a fixed cage about 5 feet 6 inches long and 20 inches wide. Meat was placed in this elevator and the lioness was enticed into it after considerable difficulty. Once the lioness was trapped, a tarpaulin was placed over the cage, making it airtight, and she was chloroformed from an atomizer pump and roped and tied. Her nails were removed.

The lioness then was placed in a sun-

lighted cage for convalescents, 18 by 14 feet, which opens on an outdoor well. She came to slowly. And what a racket she made! She roared and howled! The whole park resounded with her rage and anger! Sightseers ran up, but one look was enough. The lioness made for the bars of her well, and, though she hadn't a chance to get loose, that crowd made for the exits.

THAT lioness was well again in 10 days and lived to be 15 years old, a ripe age for a lioness in captivity. She died a year ago. And it's probably true that in the jungle she would have died sooner.

It is true that as a rule animals in captivity don't live as long as those that are free. But, on the other hand, some live longer, for the zoo provides the finest attention, gives balanced food on a strict diet, and affords protection against powerful enemies.

There's a Sambur deer, an Indian deer about the size of a European red deer, that is 23 this October and is stone blind. This sweet old lady, who has the unromantic name of Fatty, has presented the Zoo with 16 babies, and her keeper refuses to have her killed. Ordinarily, the Zoo wouldn't keep an animal not healthy, but rules are forgotten in Fatty's case. She feels her way around and her keeper guards her. A placard on her spacious cage tells the public a little about this old favorite.

AN EXTRAORDINARY operation on animals, though it is not uncommon on humans, was performed by Doctor Blair on the eyes of an Indian rhinoceros. This animal, a splendid physical specimen, came to the Zoo with two cataracts over each eye. Doctor Blair performed the needling operation, in which a knife is inserted in the eye and the capsule of the lens is ruptured in order to dilute the opacity. The operation is absolutely painless and is performed on human beings without an anesthetic, but the rhinoceros was given cocaine.

The operation was the easiest part. Preparing the patient for the operation

(Continued on page 169)

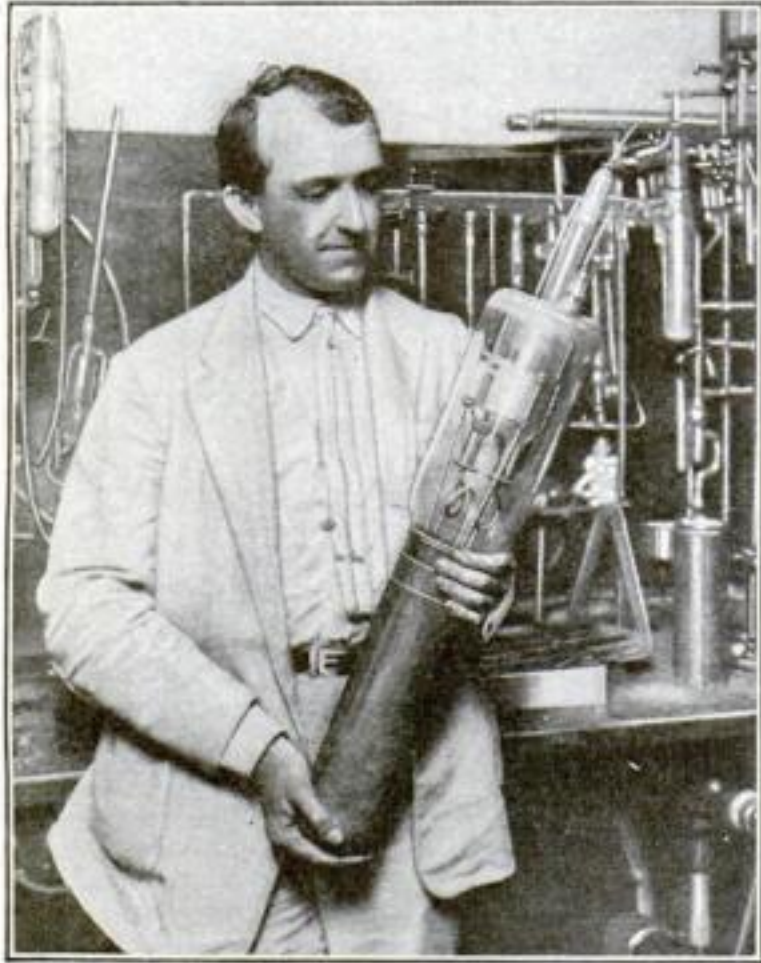


Jumbo Goes to the Dentist

Unless an elephant runs amuck, he is a great favorite in the zoological gardens, both with keepers and visitors. "Open, please," says the doctor, as he treats a bad molar

New Mileposts of Discovery

*Fascinating Achievements Mark the Progress of Science—
Einstein Challenged—A Second Niagara Found*



Makes Huge Vacuum Tubes Possible

For inventing the first practical airtight seal between glass and copper and so making possible the construction of huge vacuum tubes used in high power radio broadcasting—William G. Houskeeper, of the Bell Telephone Laboratories, recently was awarded the John Scott medal and a \$1000 prize by the city of Philadelphia. Mr. Houskeeper is seen holding a great 100,000-watt tube

EVERYWHERE, every day, men with ideas are studying, experimenting, inventing, exploring the unknown, and giving the results of their efforts to the world. The sum total of their labors marks the advance of science. It is to help you keep pace with this steady, ever-changing progress that POPULAR SCIENCE MONTHLY presents here some of the month's most important discoveries and inventions.

Will Einstein Theory Fall?

THE Einstein theory of relativity soon may fall, and we may have to look for another explanation regarding the mysterious movements of the universe. Professor Einstein himself has just admitted it. If results obtained recently by Prof. Dayton C. Miller at Mount Wilson Observatory are confirmed, he says, it means that the relativity theory does not hold.

For Professor Miller's results indicate the earth's motion through the ether. According to the relativity theory, it should never be possible for any one on earth to detect this motion. If all things in the whole universe—planets, stars, and ether—are moving at the same rate and in the same direction, the results of experiments on earth would be exactly the same as if all were standing still.

But if the earth and other bodies were moving through stationary ether, or at

different rates, then there should be a drifting of the ether in their paths that could be observed from earth.

Professor Miller first made his experiments from an underground chamber, just as Professor Michelson and Professor Gale of the University of Chicago have been doing in tests of the Einstein theory. Like them, he could detect no motion—evidence substantiating the Einstein theory.

Their results, however, possibly might be explained by "ether drag." That is, in some way heavy bodies, such as the earth, drag along a certain amount of ether in their motion, leaving the more distant ether unaffected.

To test this, Professor Miller repeated his experiment at Mount Wilson, which is about a mile high. And here he obtained the surprising results that may contradict the relativity theory. He found a marked effect that seemed to vary with altitude.

Snapshots in Colors

A SIMPLIFIED method of color photography recently demonstrated in Paris, may hasten the day when we all can take snapshots that will register green trees and blue sky.

Instead of the old color photograph method, requiring three separate exposures, Rousseau (discoverer of the new method) found that he could get better results by a single exposure of three films placed one upon the other in the camera. Only a single plate needs to be developed.

The first film registers blue and violet, the second green, while yellow, orange, and red are registered on the third.

Luscious New Berry

ONE of these days you will go to the grocery store and discover a new dewberry—one that is larger and

more luscious than any you ever have seen. It will be wine colored, somewhat darker and sweeter than the loganberry. It is more resistant to disease than the ordinary dewberry, and it is believed that the new fruit even may replace the popular loganberry on the Pacific Coast.

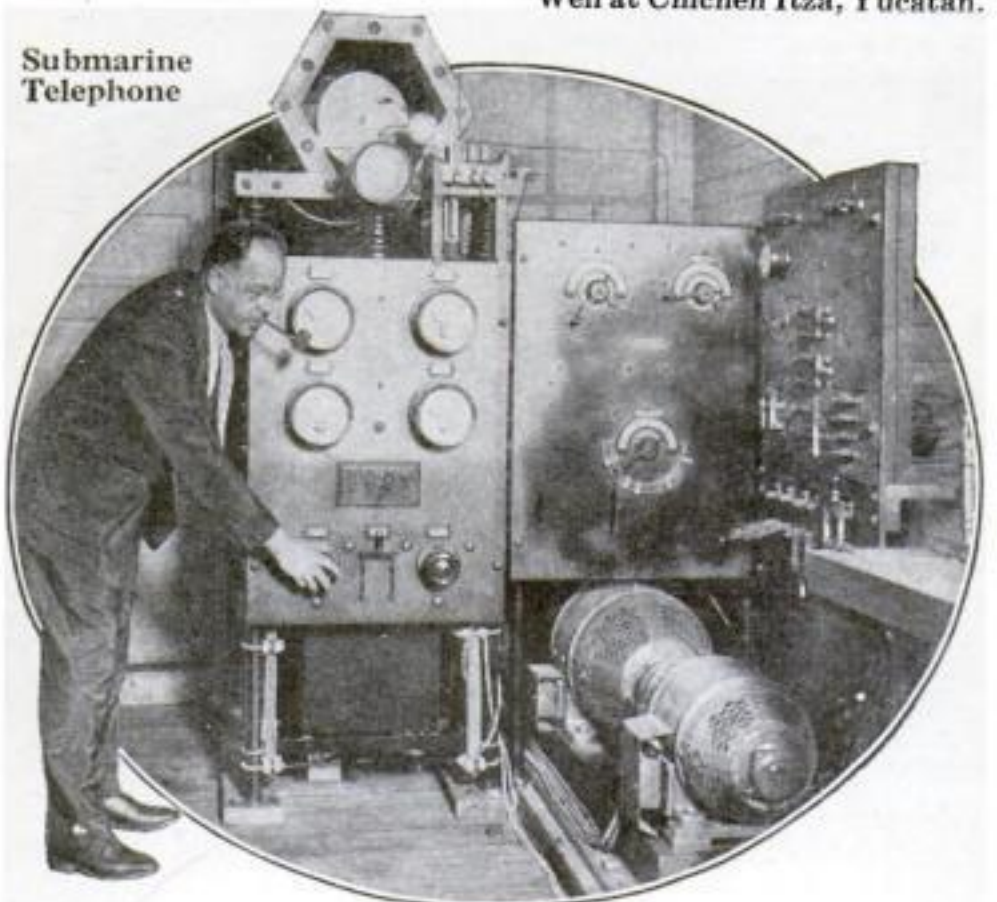
A Louisiana electrical engineer, B. M. Young, who breeds plants as a hobby, obtained the new fruit by crossing two varieties of dewberries. The United States Department of Agriculture considers the size and quality of the fruit so important that it is propagating stock so that the new variety may be released to the public through nurseries.

Another Niagara Found

A WATERFALL as great as Niagara in the midst of a barren desert was one of the sights seen by Mrs. Agnes Chase, botanist of the United States Herbarium, who has just returned to the United States after seven months in the wilds of Brazil. Looking for peculiar species of grass, she went high into the eastern plateau where the land has become a desert through overgrazing. She climbed the highest peaks in Brazil east of the Andes.

The man who revealed to the modern world the ancient Maya civilization that flourished before the time of Christ in Central America, has come home. Edward H. Thompson has spent 20 years resurrecting Maya ruins. His greatest single feat in a list that sounds like captions to a movie thriller, was diving to the bottom of the Sacred Well at Chichen Itza, Yucatan.

Submarine Telephone



This undersea telephone transmitter is part of a remarkable new instrument that makes under-water telephone communication between submarines possible. It is the invention of Dr. Harry C. Hayes, U. S. Navy physicist, inventor of the sonic depth finder and other important submarine signaling devices. He is shown demonstrating the apparatus

There, 80 feet under water, he found the bodies of 90 sacrificed maidens, together with priceless quantities of jade, gold, and incense.

The water in the well was only 40 feet deep, but below it was 40 feet of mud. Mr. Thompson went to Boston and got a job scraping the bottom of deep-sea vessels in a diving suit; then, with knowledge of this work, he returned to Yucatan. By throwing logs down into the well, he figured out the spot where the treasure and maidens must have fallen, then had the mud dredged from that part. After that came the dangerous diving, which resulted in the ultimate recovery of the treasure.

Radio Fights Forest Fires

ARRANGEMENTS are being made this year to use radio over the whole Western forest area to aid in fighting and preventing forest fires. By means of instruments that register humidity very exactly, it is possible to forecast with accuracy the sections where fires are likely to occur. With warnings broadcast, firefighters can be on the spot ready to prevent fires or control them when they break out.

Tall trees are used as poles for radio antennæ.

Are We All Abnormal?

EVERY one of us is abnormal at some time or other, according to a recent statement of Dr. George W. Henry, a New York psychiatrist. What we call a normal person is one who possesses the average characteristics of a great variety of individuals, he points out, but along with these common characteristics there are often many queer ones.

To bear this out, Doctor Henry calls attention to peculiarities of famous men commonly regarded as normal.

Beethoven, the composer, would use several pitchers of ice-water to wash his face and hands, splashing it about so that it leaked through to the ceilings below.

Forty Years of Progress
in Transformers



Compare the modern transformer (above) with the first transformer built by William Stanley in 1885, indicated by arrow and shown in lower picture. The modern unit weighs 1000 times as much and gives 10,000 times more power

Chopin was so extremely nervous that he was tormented by such trifling things as a wrinkle in a rose leaf.

De Quincey, the writer, had hallucinations and set fire to his books and papers, while Balzac believed that his

writings would reform the world. One evening, having put on a new dressing-gown, the latter wanted to go into the street with a lighted lamp to excite the admiration of the public.

Defense Guns Prove Deadly

TARGETS only five feet wide and 19 feet long, towed behind airplanes traveling 70 miles an hour at a height of 6000 feet, were comparatively easy marks for the United States Coast Artillery anti-aircraft guns in a recent test.

The recorded percentage of the hits scored was 5.6, which meant one hit for each 18 shots fired. That is about six times as many hits as were claimed for the firing at the end of the World War, say government officials.

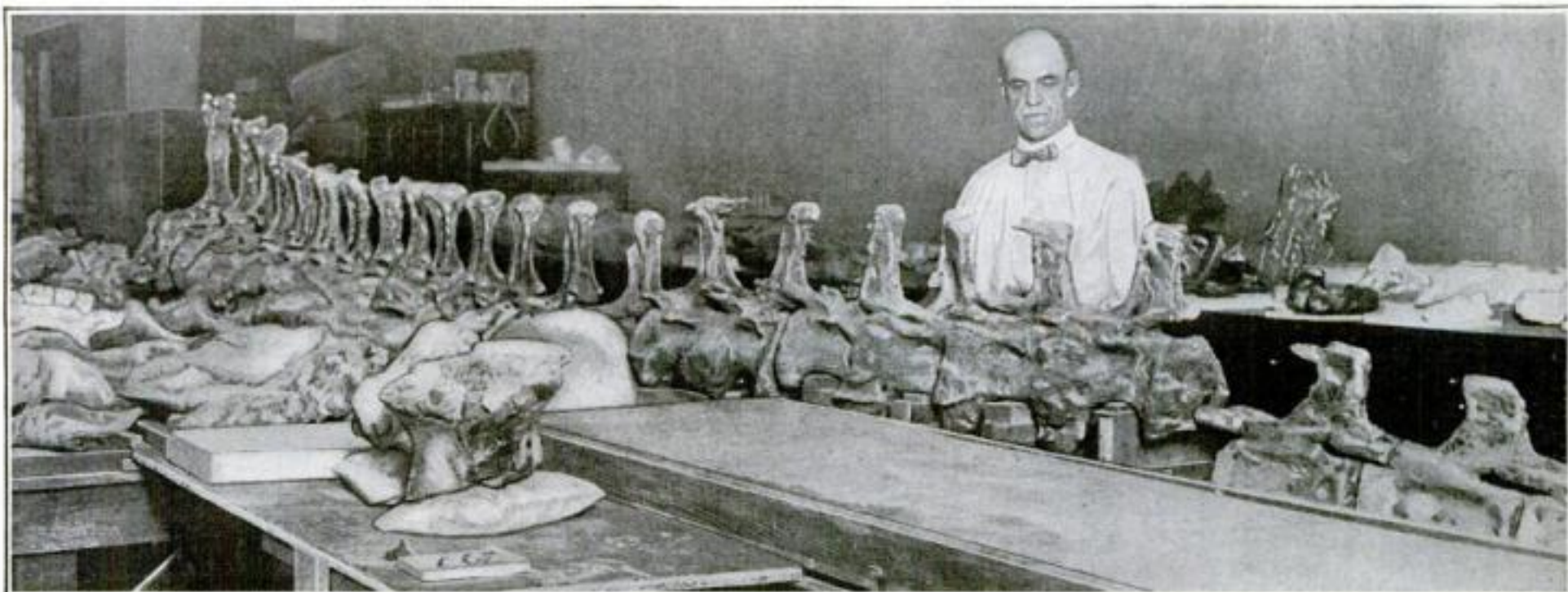
Circles Britain in Five Hours

FLYING at an average speed of 151 miles an hour, Captain F. L. Barnard recently won the "around Britain" race for the King's Cup in England. It took him five hours, 17 minutes flying time to make the circuit of 804 miles up the east coast of Britain, across Scotland, down the west coast and across the island to the starting point. He used a 395-horsepower plane. This was Captain Barnard's second victory.

Makes Old Hens Lay

AN OLD hen for chicken pie. It may be difficult to get one for this purpose if an experiment made by Dr. F. A. E. Crew of Edinburgh University becomes well known. By administering thyroid to chickens he claims he can make hens lay as long as they can cackle.

Some hens that had laid only 25 eggs in the previous four years laid more than 100 eggs during the year that they were given thyroid, he found.



Reconstructing the 30-Foot Tail of an 80-Foot Dinosaur

Professor Charles Gilmore, curator of the National Museum, Washington, D. C., is seen here at work reconstructing the tail of a huge dinosaur discovered by him at the Dinosaur National Monument in Utah in 1923.

The tail is 30 feet long and is composed of 32 vertebrae. The length of the complete animal was 80 feet. Professor Gilmore expects to complete the work of restoration of this prehistoric reptile sometime in 1927

Safety at the Switches

Dangerous Freight-Yard Jobs Now Performed by Machines



The Old and New Ways of Switching Cars

Above: Remarkable new automatic braking and switching mechanism installed at Gibson, Ind., showing control tower. At the sides of the rails are pairs of movable bars, driven by compressed air, that grip the car wheels. Right: The old and dangerous method of hand braking



Automatic Emergency Stop

An electro-pneumatic apparatus that "throws skates" mechanically to stop a wild-running freight car now is contained in a box beside the track, ready for emergency

of levers, these pairs of bars can be closed like a vise on both sides of all wheels passing between them. The retarder is so powerful that a car can be stopped and held on the steepest part of

PITCHED from the icy top of a freight car, or crushed between cars in doing his work, a railroad switchman's job is one of the most dangerous, and casualties have been appalling. For this reason a new mechanism installed in Gibson, Ind., which switches and controls the cars automatically, is attracting wide attention.

Replacing an army of switch tenders and car riders, a few towers have been erected in the railroad yards. In these elevated cabins, operators work electro-pneumatic switches, while below freight cars slide toward any one of 30 destinations.

Hump switching, the most approved method of assembling cars for given destinations, is retained in the new

system. Trains to be classified are pushed up to the crest of a hump, where each car, or group of cars coupled together, is uncoupled and allowed to run by gravity down a short, steep grade.

By the old method, as the cars raced down the incline, each had to be mounted by a rider who regulated the speed with hand brakes.

The new switching device, invented by George Hannauer, vice president of the Indiana Harbor Belt Railroad, is called a "car retarder." It consists of movable bars from eight to 10 feet long, assembled in units of from 32 to 40 feet, in pairs on either side of each rail. By means of a compressed-air cylinder and a system

the incline whenever necessary.

Two hundred and forty feet of retarders arranged in seven units with space between, give the first operator control of movements down the incline. Forty-four other units distributed about the yards are operated by four other men.

An ingenious auxiliary of the retarder is a "skate throwing machine" to halt any car running wild. By the movement of a lever in a control cabin, an electro-pneumatic device places a heavy cast-iron wedge on the track to bring the unruly car to a stop. The former method of "throwing skates" by hand was extremely dangerous, resulting in many deaths.

Ingeniously Simple Water Turbine Develops Cheap Power

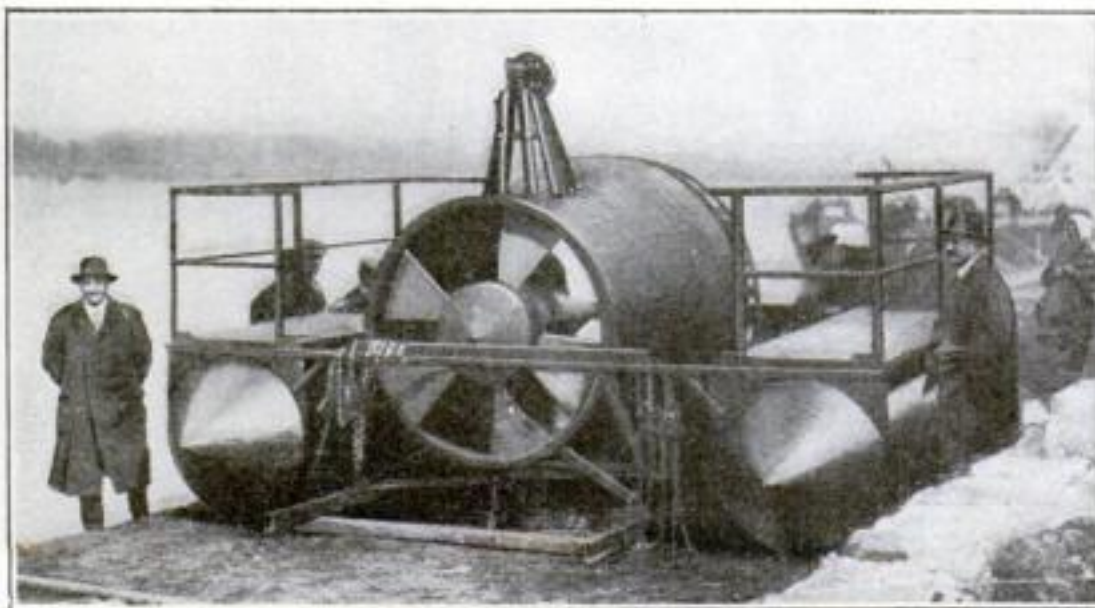
ECONOMIC utilization of the energy represented by the flow of water in rivers and other water channels always has been a problem. Where the angle of descent, the drop, is great, or where natural falls interrupt the flow, the solution of the problem by dams and artificial falls or by the construction of sluices regulating the volume and direction of the falling water, is comparatively simple. But in nearly all cases the engineering work involves the expenditure of money, often entirely out of proportion to the results obtained.

Recently Eduard

Suess, an engineer of Vienna, invented a water turbine of a new type, simple of construction, inexpensive, and developing

a high degree of power for plant use.

The Suess turbine consists of a slightly conical housing, with a built-in four-bladed propeller. The turbine is submerged in the stream and is securely anchored in position, with the smaller opening of the housing pointing against the current. The water, entering through the smaller opening and passing out through the larger, relieves the propeller of stemming counter pressure and greatly increases its power. The Suess turbine, being submerged entirely and resting on the bottom of the river, does not interfere with navigation.



Powerful water turbine invented by Eduard Suess, Vienna engineer

Human Eye Outdone by New Color-Sorting Machine

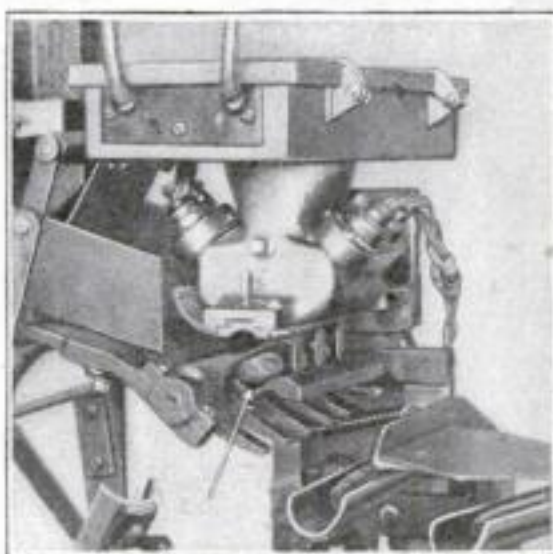
AFTER five years of patient experimenting there recently has been perfected a remarkable machine that automatically separates cigars into 30 different groups, depending on the shade of the wrapper.

The machine consists of a finger that picks up each individual cigar, a photo-electric "eye" that measures the color, an amplifying panel that boosts the infinitesimal current generated in the eye, a switching ammeter that actuates the mechanical sorting mechanism, and a set of 30 compartments arranged around a common center into which the cigars are passed skilfully.

The cigars are fed into a hopper mounted above and to the side of the photo-electric cell. From the bottom of this hopper an ingenious split finger picks the cigars one by one with meticulous care and carries each to the bottom of the "eye" tube.

The "eye" is a tube with two terminals connected with a battery. One terminal is enlarged within the tube and heavily coated with potassium. The entire tube is covered by a lightproof case, and in the darkness no current flows between the two terminals. Light, however, activates the potassium-covered end and permits current to flow.

Below the "eye" is another chamber containing four small electric-light bulbs, shielded from the tube above. When the finger places the cigar in position within this lighted chamber, a shutter opens a slit in the covered tube chamber above it, and only the light that is reflected



Cigar Color-Sorting Machine in Operation

Feeding cigars into the machine to pass under the photo-electric eye, which automatically sorts the cigars and drops them into the correct compartments of circular table. At left: Arrow points to mechanical finger that is about to hold up cigar to the "eye"

from the wrapper of the cigar is permitted to act upon the tube. The actual color of the cigar, then, determines the amount of current permitted to flow between the

two tube terminals. And, since every color reflects a different amount of light, the machine's color-sorting abilities depend on its detection of varying currents.

Remarkable Bullet-Proof Gas Tank for Airplanes

UNDoubtedly the greatest menace to the pilot of the fighting airplane is the danger of fire caused by an enemy bullet's penetrating the gasoline tank. Even if a bullet hole

in the tank does not immediately burst into flames, the gasoline will flow out and the aviator will be forced to land.

Mario Garagnani dei Pescara, an aviator during the war, has just patented a gasoline tank that, he claims, will overcome these difficulties. It consists, really, of two tanks, one inside the other. Both inner and outer shells are made of fiber one-eighth inch thick. In addition, there is a one-fourth-inch layer of granulated sheet cork and a one-sixteenth-inch layer of sheet rubber on the outside of the inner shell, and a lining of the same kind on the inside of the outer shell. This arrangement brings the two layers of rubber in contact with each other.

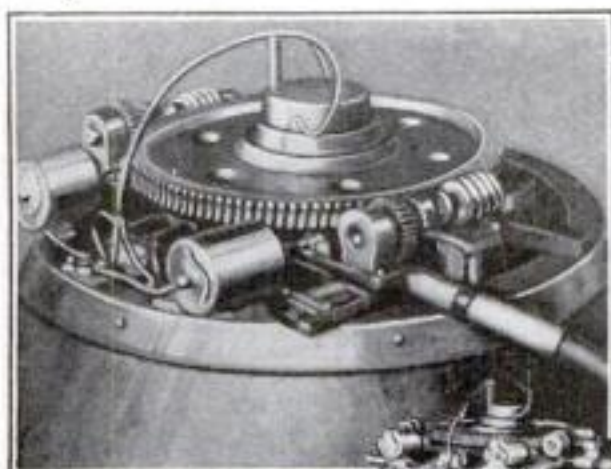
The operating principle upon which the tank functions consists of rotating the inner shell a few inches each time a bullet penetrates the tank. Castor oil is used as a lubricant, since it has little deteriorating effect on rubber.

On the end of the tank is located the mechanism that automatically rotates the inner shell when a bullet strikes the tank. The expansion of the fluid in the tank, caused by the rapidly moving projectile, indirectly throws electrical switches that engage two clutches and these transmit power from a flexible shaft



Greater Safety for War Pilots

The inventor adjusting the flexible shaft that transmits power from the airplane motor to the mechanism that operates his bullet-proof gas tank



The Controlling Mechanism

When a projectile strikes the gas tank, it causes an expansion of the gasoline. This expansion starts the mechanism, which revolves the inner tank enough to close the newly made hole. Note the wheel that turns it



connected with the motor of the airplane to the worm gear that rotates the inner cylinder. The rotation places the hole in the inner tank in contact with the wall of the outer tank and this stops the leakage of the fuel.

The tank was tested recently by the United States Army Air Service and it is stated that it withstood not only the terrific shock of the .50-caliber machine-gun bullets, but that the controlling mechanism functioned perfectly and stopped the leakage that ordinarily would have drained the tank. A means is provided for automatically disconnecting and dropping the tank from the airplane.



New Army Gas Mask Has Phone for Field Work

GROTESQUE is the telephone gas mask, developed recently by the U. S. Chemical Warfare Service. It is designed chiefly for use by advance posts during attack, that the wearer can telephone information to stations in the rear.

The wearer is said to be heard clearly even in the heaviest firing. The telephone connection is inserted near the mouthpiece. When the mask is adjusted, the wearer is unable to speak to any one near by. His only means of communication is by telephone.

Scientist Uncertain if Tortoise Is Deaf or Stupid

TORTOISES are either deaf or stupid. Most water snakes cannot hear at all, but land snakes often have acute hearing. These interesting conclusions were reached by Ryo Kuroda of the College of Niigata, Japan, after extensive experiments with reptiles.

To test the tortoise's hearing, scraps of meat were laid on a broad copper plate. When the tortoise attempted to snap up a bit, a bell was rung and at the same time an electric current was passed through the plate. The idea was that if the tortoise could hear, it would soon associate the ringing of the bell with the shock. But repeated experiments showed that the ringing of the bell meant nothing to the animal. It snapped for the food, anyway, and was just as surprised by the shock each time.

British Scientist Says Men Can Live for 150 Years

AT THE mere cost of 12 cents a head, the span of life may be extended to 150 years, claims Sir Ronald Ross, the British scientist, whose researches have led to cures for malaria and sleeping sickness. His idea is that 12 cents from the pocket of every Englishman spent in scientific research would result in a new medical knowledge that would keep germs and old age away so that man easily could live 150 years. He thinks that the allotted span of threescore years and ten should find man in the prime of life. We live curtailed lives, he says, because we are the prey of countless germs.

Newest Umbrella Folds into Thin Ten-Inch Roll

WHEN the shower is over, you roll up the umbrella and put it in your pocket. The roll is only 10 inches long and 2½ inches in diameter.

Frank J. Pugel, of Pueblo, Colo., the inventor of this ingenious device, is a true friend of the man who hates to carry an umbrella. The ribs of the umbrella are hinged in the middle so that the outer half of the top folds back, while the inner half folds in like the ordinary umbrella. The handle telescopes.

Opening and closing the umbrella is done by screwing or unscrewing the handle a few turns.



How umbrella looks opened and closed

A BILL has been proposed in the California Legislature requiring all persons who make camp fires to carry a license. This is intended to stop forest fires, which have caused such heavy losses of valuable timber every year.

Government Tests Beef by a Chewing Machine

THAT tough beefsteak—would it afford you any satisfaction to know exactly how tough it is? Anyway, the United States Bureau of Standards is interested in knowing just what is expected of a man's teeth when he is served broiled, baked, or boiled Texas steer.

The photograph at the right shows a machine devised by the bureau to twist or mechanically chew beef while an automatic counter on the machine records its efforts.

The Bureau of Standards has not advertised this machine as a household device, yet there may be a demand for similar machines from the long-suffering



Neck-Shaped Air Pillow Assures Travel Comfort

SHAPED to fit around the neck, a new air pillow, used as a head rest, is suited especially to the needs of travelers. In spite of the pitching of the boat on shipboard or the shaking of a train, a person can enjoy sleep with a cool pillow such as this that stays in place. It can be used, also, in automobiles or for invalids.

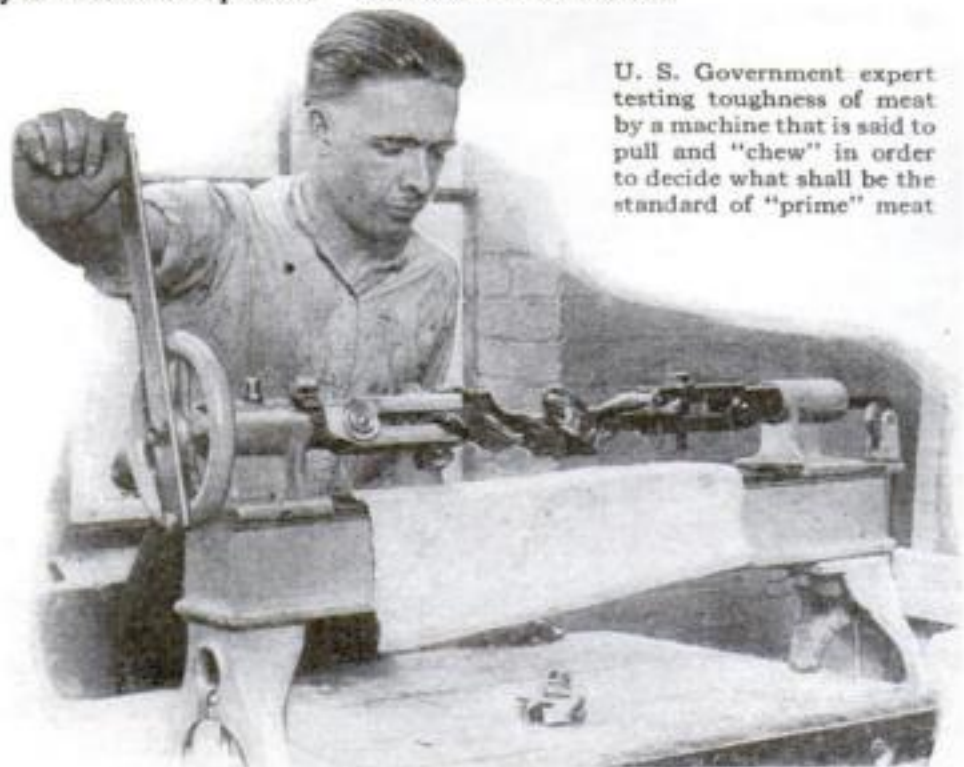
The pillow, when folded, may be carried in a coat pocket or handbag. The tapes are supposed to be drawn across the chest and fastened about the waist.

Cannot Tell Sex of Chicken by Shape of Egg

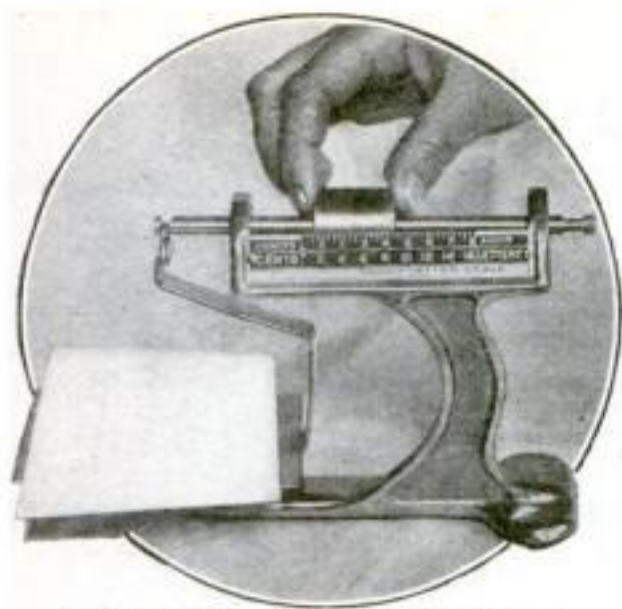
SOME declare that long, slim, heavy eggs produce roosters, while the small and shorter ones become pullets. The U. S. Department of Agriculture says that you can tell nothing about the sex of a chicken from the shape, size, or weight of the egg. You can tell it only after seven or eight days of incubation of the egg.

Experiments have determined that the greater the number of eggs a hen lays before being put into the breeding-pen, the larger will be the proportion of females produced by her eggs.

housewives, who could use it to prove to the butcher that the steak is too tough for family consumption and must be returned, or to their husbands that it is tender, as occasion demands.



U. S. Government expert testing toughness of meat by a machine that is said to pull and "chew" in order to decide what shall be the standard of "prime" meat



Novel Gravity Scales for Weighing Light Mail

THIS new scales for weighing letters and other pieces of mailable matter is operated entirely by gravity. There are no springs to become weak with age and give incorrect weights.

In operation, the letter is placed on the pan and the cylinder weight is moved along the rod until a balance is struck. Then the weight is read from the measure below the cylinder at the point where the line is cut in the cylinder.

Cardboard Is Used for Kitchen Utensils

RECENTLY invented and patented in England is a process by which cardboard pressed into the shape of various kitchen utensils can be so treated as to render it waterproof and acid-resisting. The cardboard kettles and saucepans are dipped into a solution of asphalt, resin, shellac, and spirit and allowed to dry in the air. It readily can be seen that the process offers wider possibilities than mere kitchen utensils.

Hanging Weight Holds Papers Securely on Spike File

WHEN the electric fan is running or a gust of wind comes tearing through the open windows of a busy office, papers are likely to blow off the spike type of letter file.

J. M. Milling, a telegraph operator at Dallas, Tex., got tired of chasing telegrams that blew off his desk whenever he had the windows open or the electric fan turned on, so he invented the new letter file illustrated.

A weight suspended on a chain, hanging from a crosspiece above the spike, prevents the papers from blowing away and yet it does not obstruct the sharp point of the file when papers are to be slipped on.

The loose-hanging weight prevents papers from being blown off this spoke-shaped file



CANADIAN sugar, which comes from the leaves of the Douglas fir-tree, is now being studied intensively by Prof. John Davidson, botanist of the University of British Columbia. This sugar is an exudation from the needles of the fir, and sometimes hangs from the tips of the leaves. It is exceedingly sweet.

Stout Co-Eds Grow Slim by Machinery

A person desiring to get thin, lies with nose compressed and mouth covered with rubber that leads into an air tube. Her breathing registers on a dial the smallest amount of food on which she can live. If she adheres to this amount, she will lose weight



A MACHINE that tells them how to reduce has captured the interest of women students at Columbia University in New York City. The student lies down, a rubber mouthpiece is clamped over her lips, and a pair of pincers fastened on her nose. The mouthpiece leads to a tube through which air is driven by an electric motor. A dial records the air pressure for 10 minutes.

From the reading, telling the amount of oxygen consumed, the number of calories or food heat units needed by the student, can be figured.

The small dial can tell the smallest quantity of food on which the girl can sustain life. The rest of the reducing process is merely keeping her daily rations near that limit, which, she may protest, is the hardest task of all.



Adjustable Apparatus Gives a Straight-Line Bob

PERHAPS not quite as good, but almost as good as when the barber does it. A device has been invented to help the mother make her children's home hair bobbing look more professional.

A metal gage fits on the head like a cap. It may be adjusted with a screw in the middle to the length of hair wanted. Follow the lower edge of the bottom band with the scissors, and a perfect bob, it is claimed, will result. The apparatus is also a time-saver, for this method of cutting takes only a few minutes.

Marvelous "Brass Brain" Has 15,000 Separate Parts

THE "brass brain," a device that can predict what the tides will be in any seaport in the world at any time—for tomorrow or 100 years from tomorrow—is in constant use in the laboratory of the Coast and Geodetic Survey, in Washington, D. C.

The machine is said to do the work of 60 mathematicians, and actual check on the predictions proves it to be nearly 100 per cent accurate. At present the "brass brain" is being used to predict the tides at 85 ports all over the world. As a result of these predictions, the department is able to tell two years in advance what the high-water mark will be at 3500 other ports.

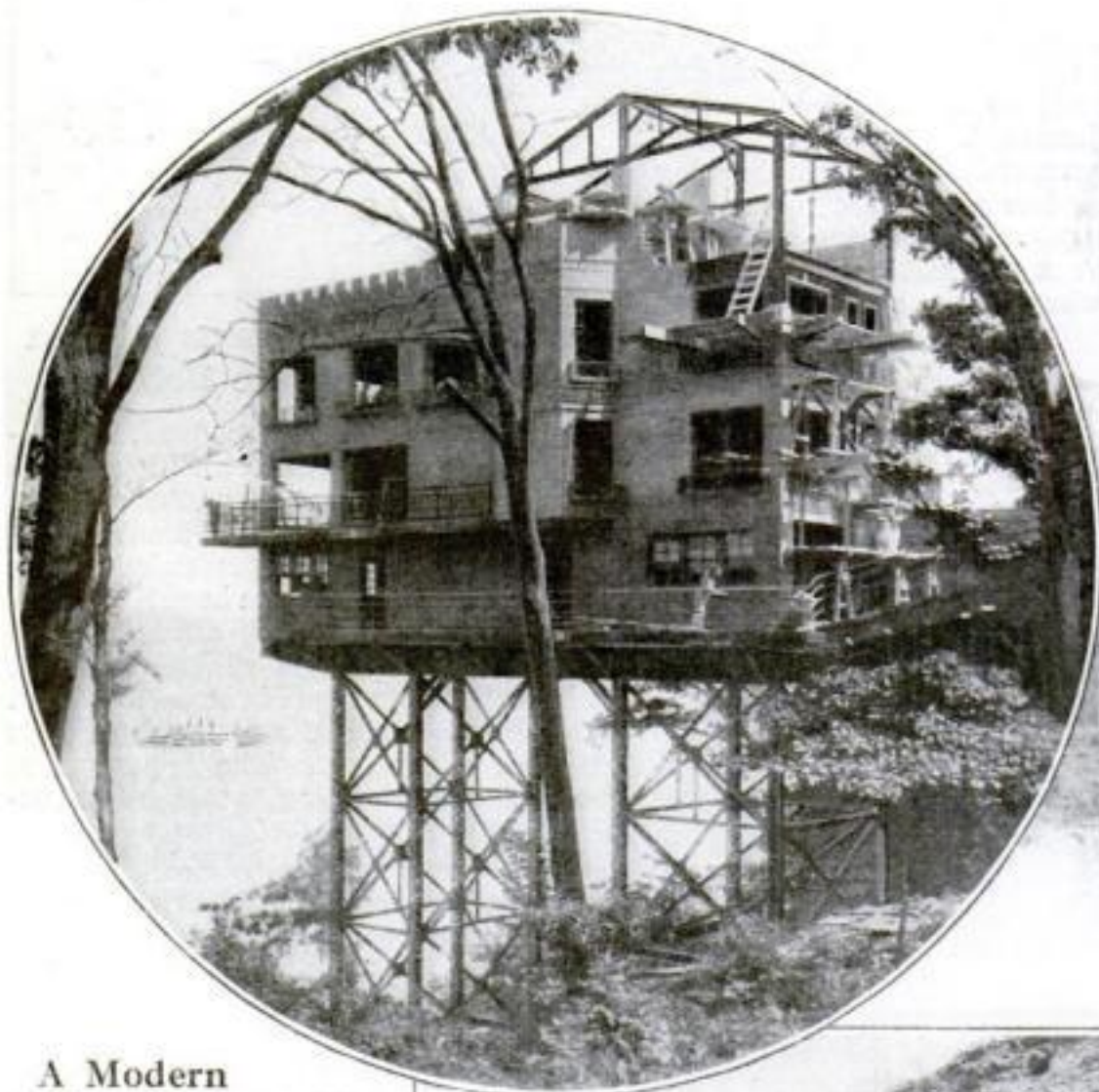
The idea was conceived by R. A. Harris, Chief Mathematician of the department, and the plans and construction were under the direction of E. G. Fischer, M.E. It took 15 years to perfect, and its name is derived from the fact that practically all of its 15,000 parts have been made of brass.

Even the extra day in Leap Year is given consideration by the wonderful "brass brain."

New Bank-Teller's Cage Is Robber-Proof

WHAT is claimed to be a bullet-proof, gas-proof, and robber-proof bank-teller's cage, was invented recently by H. P. Grohn, a mechanical engineer of Chicago. The cage is made of sheet steel. A series of mirrors, a speaking-tube, and a patented lock drawer are designed to protect completely the bank employee and yet enable him, while dealing with legitimate customers, to maintain a sharp lookout on all sides for robbers.

Queer Homes — *There's No Place like Them*



A Modern "Tree Dwelling"

The primitive tree-dweller's idea of a home has been combined ingeniously with elaborate twentieth-century architecture in this remarkable "house on stilts" that is nearing completion for Cleveland Walcott on Riverside Drive, New York City. Instead of resting in the trees, however, the residence is supported by tall steel girders. It is high on a cliff overlooking the Hudson River, and when finished will provide an unusual amount of light and fresh air.



Comfort in the Desert

By tunneling into a mountain and constructing most of his house under the earth, a Barstow, Calif., resident finds protection from intense heat.



Home in a Water Tower

A water tower that stores 30,000 gallons to supply the town of Thorpeness, England, recently was camouflaged into this unique five-story house, where lives the family of Mrs. Malcolm Mason, a well known writer of children's stories and poems.



Its Roof Is a Parasol

For protection from the hot sun, this emergency hospital building at Needles, Calif., carries a parasol in the form of a second roof set a few feet above the regular roof. The intervening air space serves as insulation, keeping the house cool.



A Seaside Boat Cottage

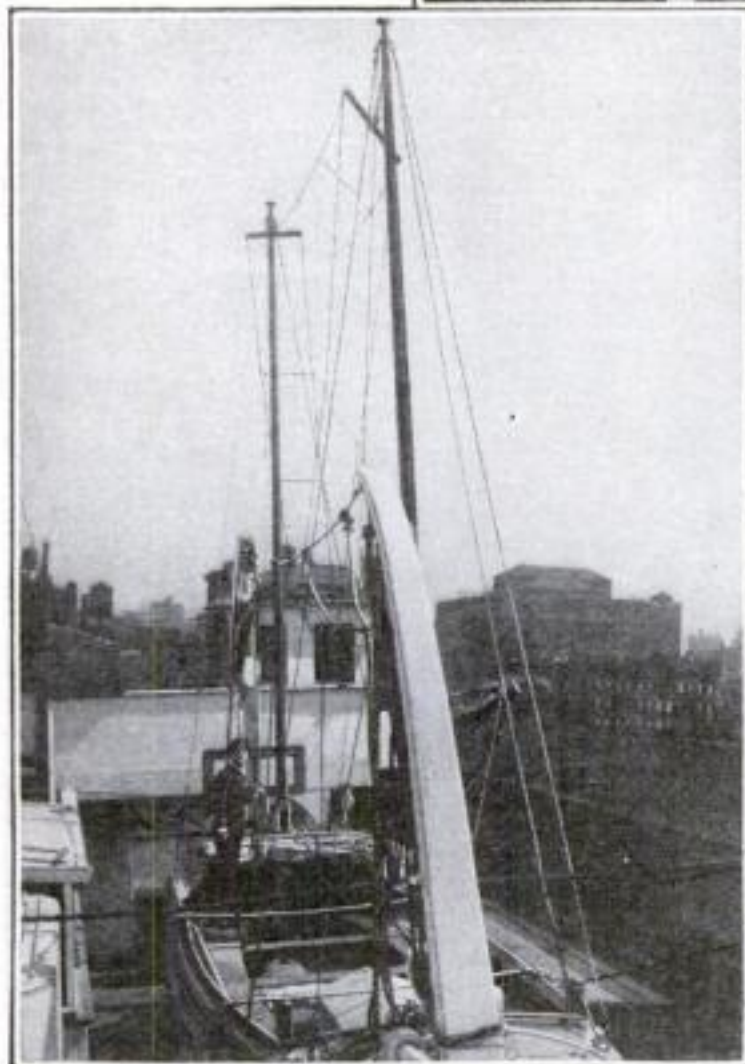
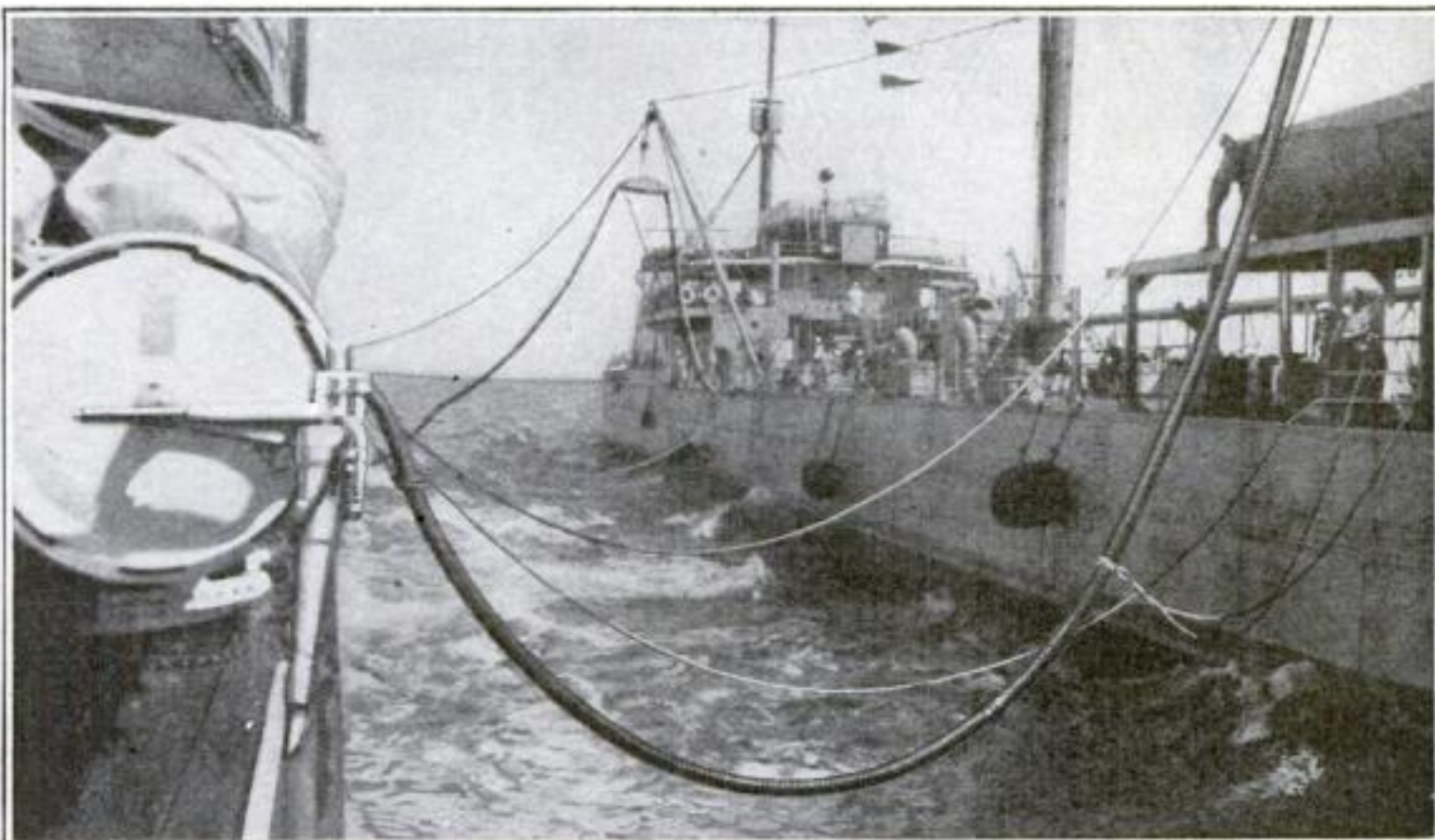
At Aldeburgh, England, a ship recently was called into service to help solve the housing problem, as shown at the left. A second story was built above the hull, with shingled exterior and a tin chimney.

Where Science Goes Down to the Sea

New Wonders of Marine Engineering and Invention

A Service Station for Ships

No longer need Uncle Sam's warships hurry to shore to replenish their fuel supply. To-day there are filling stations along the ocean highways, just as there are service stations along country roads. These ocean stations are tankers to which oil-burning vessels tie up for fuel. The photograph at the right shows a U. S. destroyer at sea taking oil from a tanker through a long hose stretched between the two tied vessels.

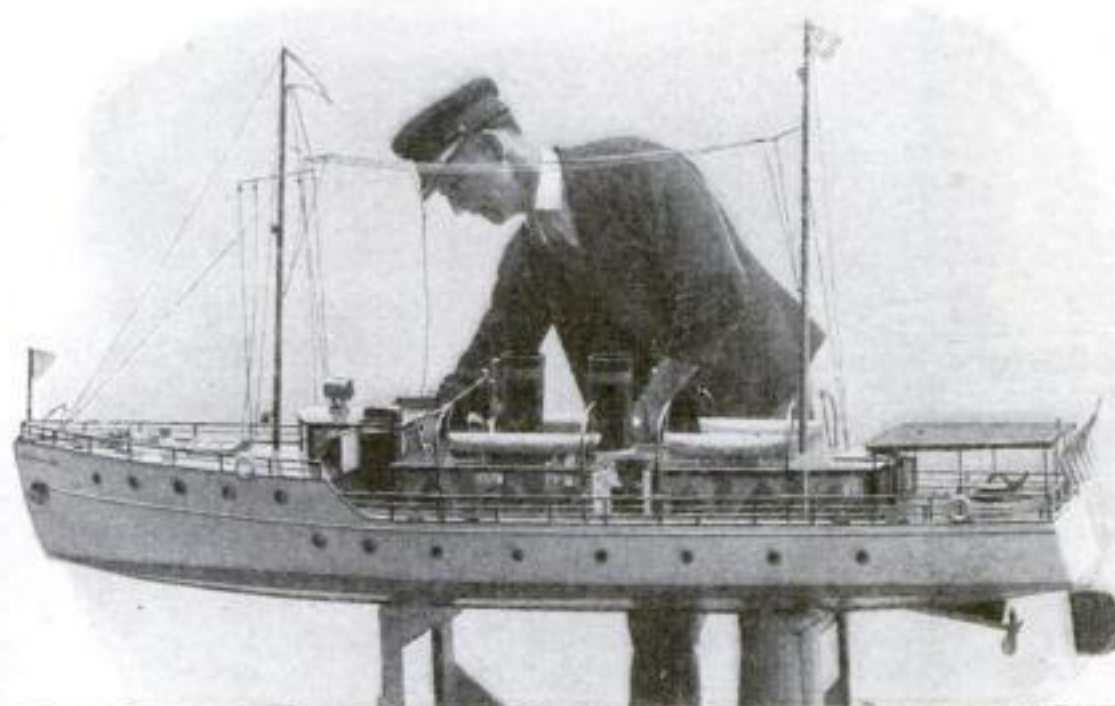


Radio for Lifeboats

Under a new British law all passenger ships must carry at least one radio-equipped lifeboat. The above picture shows one of these boats with antenna masts on the S. S. Orbita. It can send messages 100 miles.

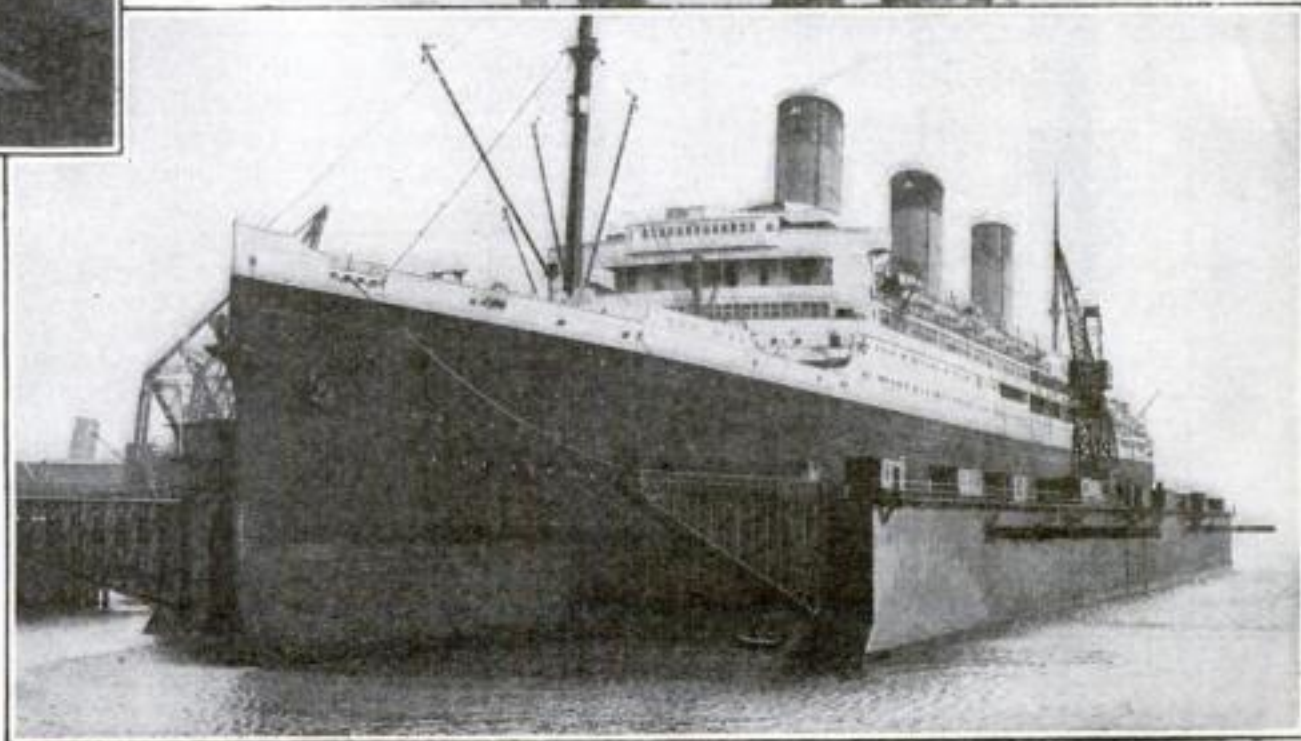
Model Electric Yacht Equipped with Radio

Electric lights and even radio are part of the elaborate equipment of an electrically driven model yacht built by C. B. Hollis, of Brooklyn, N. Y., shown below. The craft, 40 inches long, is driven by concealed dry batteries.



Lifting the Majestic

A world's record in weight lifting was made recently when the huge 60,000-ton floating drydock at Southampton, England, lifted the great Atlantic liner *Majestic*, weighing 56,551 tons, high and dry, as shown

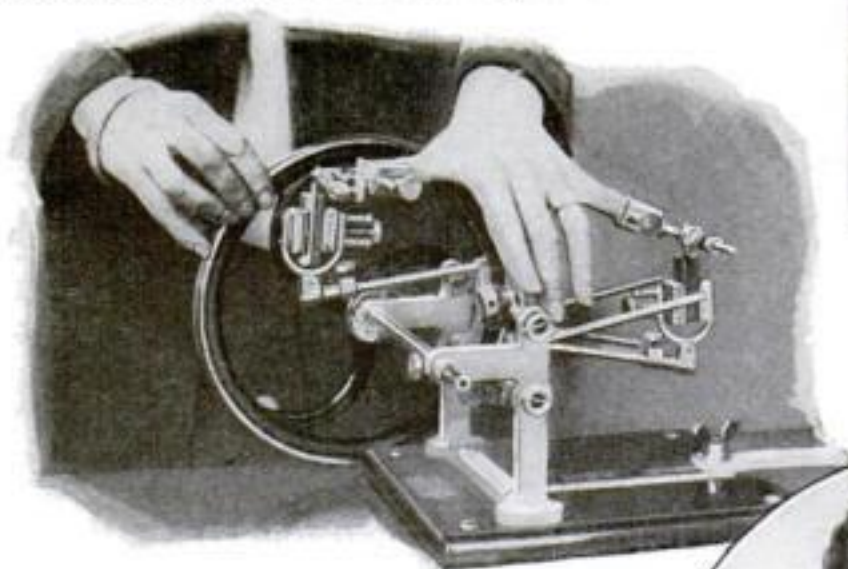


Device Limbers Pianist's Hand

MAKING fingers supple by machinery is a new and royal road for pianists, said to do away with hours of tedious finger exercises. A Frenchman has invented a machine for limbering up the muscles of the fingers.

The natural tendency is for all fingers to work together. To counteract this, an apparatus has been devised that makes every finger move separately. Five minutes of machine exercise, the inventor claims, is equal to half an hour of technique practice.

Light pressure of thumb-screws holds the fingers in place in sockets. An eccentric cam makes the fingers move in various ways entirely contrary to instinct; another machine trains in octave spreads.



How fingers are held on limbering machine

Diesel Engine Supplants Mule in Newest Canal Boats

TWO low, oddly shaped boats have been put in operation between New York and Duluth by way of the New York Barge Canal and the Great Lakes. Instead of the familiar snub-nosed prows of the old canal boats, the new ones are pointed at the front like torpedo boats. The hulls are constructed entirely of steel and the pilot house is placed exactly amidship.

From a distance the canal boats look exactly like giant submarines just coming to the surface. They are nearly three times the length of the old-fashioned canal boat, but retain the same width and low decks.

They are driven by Diesel engines, making 10 or 12 miles an hour, nearly five times the speed of the mule-drawn canal boat. A large section of the hold is equipped with refrigerating apparatus.

Movie Star Wears a Watch in Her Shoe-Buckle



Watch is set in ribbon of slipper

"HER feet kept time as the music played." There is now a more exact meaning for that phrase since a watch found a place in shoe-buckles. The one illustrated is a tiny Swiss model worn by a famous movie star.

A question suggested by this unusual way of using a timepiece is: What happens to the watch when the lady's feet are stepped on?

Bottle Lock and Key Save that "Pre-War Stuff"

A BOTTLE under lock and key is not a new thing. But in this instance, the lock is not on the cupboard, but on the bottle itself. The butler or friend who would help himself to the contents without the owner's permission, is foiled.

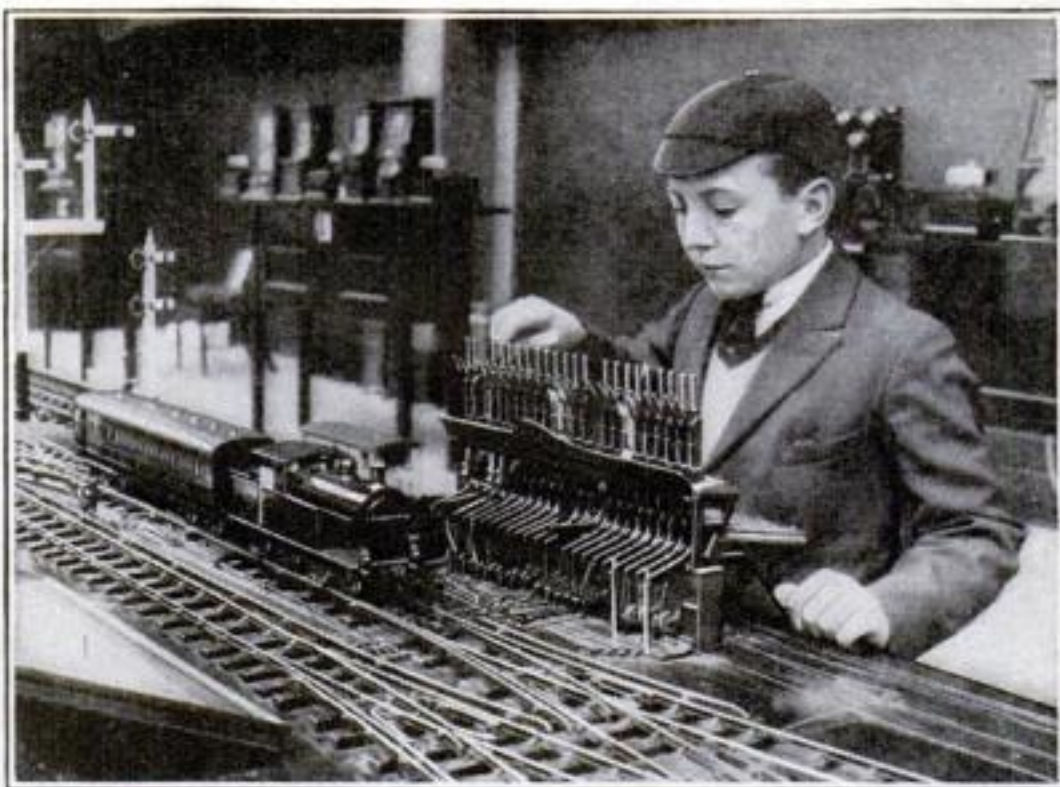
Only the owner possesses a key that fits the lock and that goes on his personal key-ring. Not a drop of the beverage escapes without his knowledge.

NEWSPAPER files usually last about 20 years. The New York Public Library now has each newspaper sheet pasted between tissue-paper, which should prolong the life of the file about 100 years.

Model Eiffel Tower Is Made of 11,000 Toothpicks

ELEVEN thousand toothpicks and 300 hours of time were put in this unique model of the famous Eiffel Tower in Paris. The only tools that Meyer Stein, 19 years old, of New York City, used in making it were a pot of paste and a pair of tweezers. Each toothpick had to be handled singly.

The young model-maker is a student at the New York College of Dentistry, which may account for his choosing toothpicks for building material.

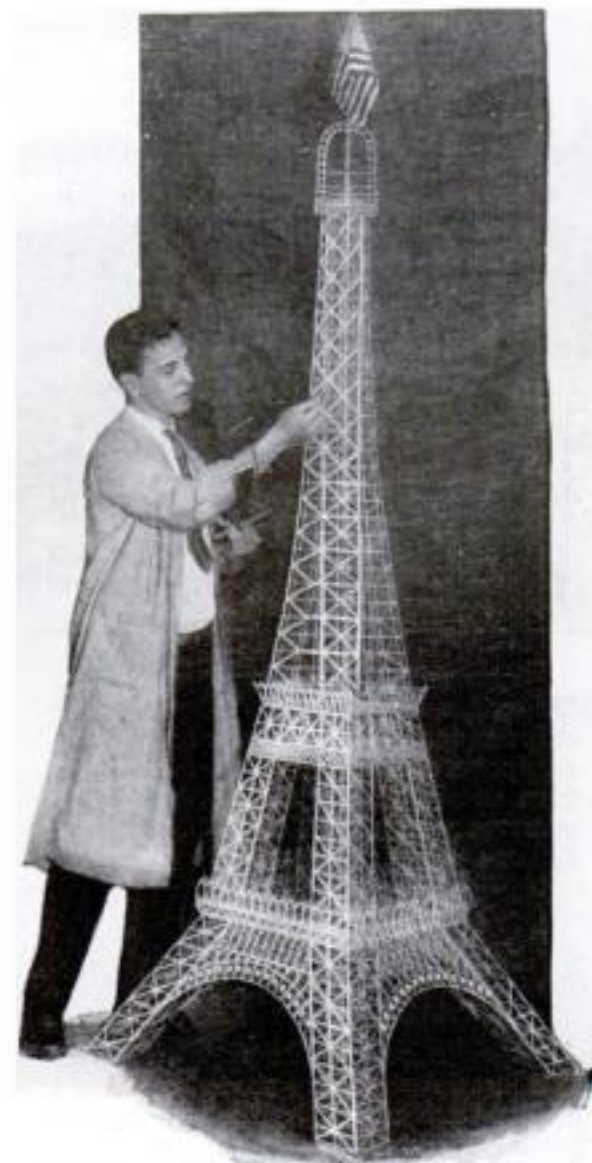


Controls Train 300 Miles Away

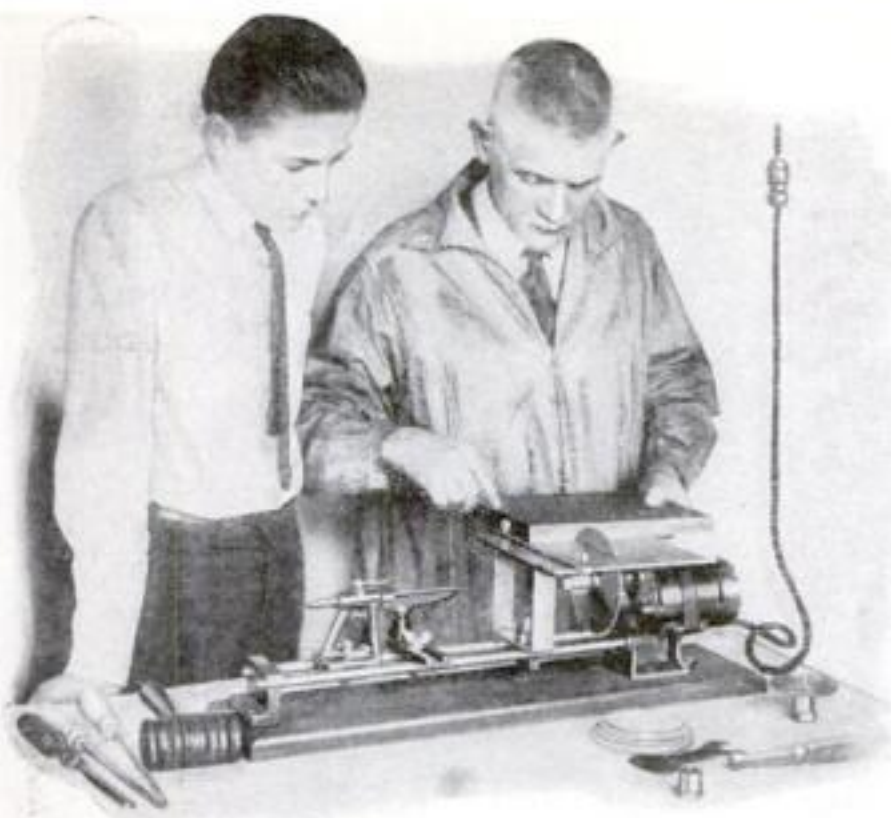
BBRITISH railroads, as a feature of their one hundredth anniversary, are demonstrating at the British Empire Exhibition at Wembley the most modern methods of control and various new signaling devices.

Electric lights on a control board indicate the progress of trains on 300 miles of line. The photograph above shows a signaling installation model of train-control methods as used in the British Empire today.

ONE hundred new flowers were brought to the United States recently when Dr. Francis W. Pennell, of the Academy of Natural Sciences, Philadelphia, returned from an exploration trip to Chile and Peru. They are all species of the foxglove, snapdragon, and lady-slipper family.



Each toothpick of this beautiful model had to be put in place separately with tweezers



A Portable Machine-Shop

WHEREVER there is an electric-light socket, the handy man can have a power workshop. Sawing, buffing, lathework, grinding, drilling, polishing, and cleaning can be done with this new compact metal and woodworking outfit.

A power lathe bolted to a platform is operated by a simple back geared motor. Sticks 12 inches long, and bowls or candle-stick bases as large as six inches in diameter can be turned on the lathe. Holes may be drilled in steel up to one-fourth inch in diameter and in wood up to one-half inch.

The outfit has a metal cover and may be carried to the job.

THIRD-DIMENSION motion pictures, ones that have depth effects as well as width and height, are produced by a new moving-picture camera exhibited in Chicago.



Jascha Heifetz and his new violin-cane

Famous Violinist Brings a Unique Cane from Europe

WHEN Jascha Heifetz, the famous violinist, returning recently from a trip to Europe, walked down the gangplank of a steamer in New York, he carried a curious cane. It had the shape of a heavy walking stick, but it had strings like a violin and actually could be played.

It was a souvenir from abroad that the artist had "picked up," as the tourists say, and for which he had paid \$400. Mr. Heifetz was delighted with the unique instrument, and said its tone was really not at all bad.

Smallest Lighthouse Model Is Made of War Waste

MADE by a sailor, this unique model lighthouse is accurate in every detail. Daris Hussman completed it recently for the United States Shipping Bureau, after working on it nights for three years.

It is made of 36 shells collected from the battlefields of France. The lighthouse is electrically lighted and is equipped with a motion-picture projection machine light that casts a beam that may be seen for quite a distance. Looking through the little windows one can see a kitchen and other living-rooms of the lighthouse, completely furnished.

BUTTER that keeps longer is being made in Holland by churning it in the presence of carbon dioxide. The air that is naturally in a churn is drawn out and replaced with carbon dioxide. Part of this works into the butter and remains there a long time, keeping out air, which is the chief cause of deterioration. The increased expense of this method is said to be small.

Where the Diver Met Her Shadow

MOST unusual was the photograph taken recently at the opening of the largest swimming-pool in the world, built at San Francisco. The honor of the first splash was accorded to Miss Mavis Cochrane, a co-ed at the University of California. When Miss Cochrane dived, a murmur of admiration arose at the graceful flight. Only a few near-by spectators saw what the photograph shows—a reflection so clear that it had the appearance of another diver beneath the water meeting the real diver above.

The new pool is 1000 feet long, 150 feet wide, and requires more than 6,000,000 gallons of water. The cost of the pool and building, which has 750 dressing-rooms, was \$100,000. It could accommodate easily all swimming contestants in the Olympic Games.



Unusual reflection of a diver

IN A new Cunard liner all the clocks are driven electrically and controlled by a master clock. This has a chronometer escapement instead of a pendulum.

Bicycle-Scooter Is Newest Plaything for Children

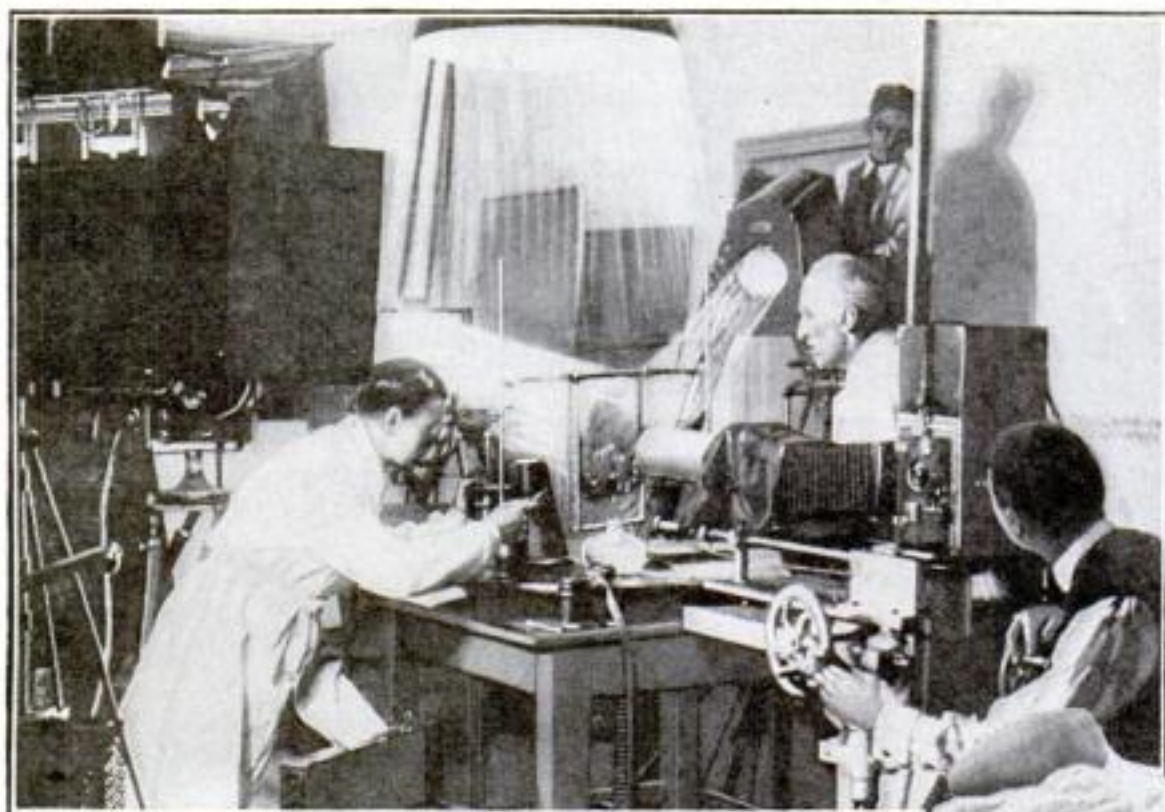
THE little fellow who wants a bicycle like dad's will be delighted to know that a new plaything has just been put on the market for him. It is a scooter-bike, a cross between a scooter and a bicycle, as much fun as a bicycle, but easier and safer to ride.

It has rubber tires, a spring bicycle seat and handle-bars. The rear wheel is free, while a hand brake is provided for the front wheel. An adjustable seat permits the bike to grow with the child. Another model, keeping up to the minute in style, has balloon tires and a parking stand.



Popular new bicycle-scooter is built also with balloon tires and a parking stand

Bees Are the Heroes of Interesting Movie



THE bee is the latest movie star. The story of its life, full of adventure, travel, and savage warfare, is being recorded in a European moving-picture studio.

Doing this accurately requires the assistance of a large staff of camera experts and scientists. They wear head nets and hand protectors while at work to avoid being stung by the insect actors.

Two of the most interesting parts of the unique film show the building of the hive with its marvelous architecture, and a war against hornets.



Above: Setting the stage. Below: A director

Nest of Largest Bird Is Found in California

IN THE mountains of Ventura County, Calif., E. A. Brown, a young hunter, recently discovered a nest of a pair of condors. The condor is the largest bird in North America, and is believed to be the largest flying bird in the world, sometimes having a wing spread of from nine to 11 feet and weighing about 35 pounds. There are only about 50 pairs of these birds in the United States, and stealing their eggs or killing them is punished in California by a heavy penalty.

The cave nest, with an entrance only large enough to admit one condor at a time, was at the top of a solitary 200-foot pinnacle, standing at the end of a canyon. Brown climbed the rock, crawling the last 100 feet on his stomach. While midway along the ledge on which the cave opened, the two condors swooped at him continually.

Brown saw and handled the one egg the nest contained. "The nest," he says, "was merely an unlined natural depression in the rock floor of the cave, in which rested one pale greenish blue egg, about $1\frac{1}{2}$ times as large as that of a domestic goose. This egg seemed to have a very thick shell and was very heavy."



Museum exhibit of condors and their nest



Dinosaur skeletons moved by electric truck in New York's Museum of Natural History

Mouselike
Deer Come
from the
Island of
Ceylon, in
India

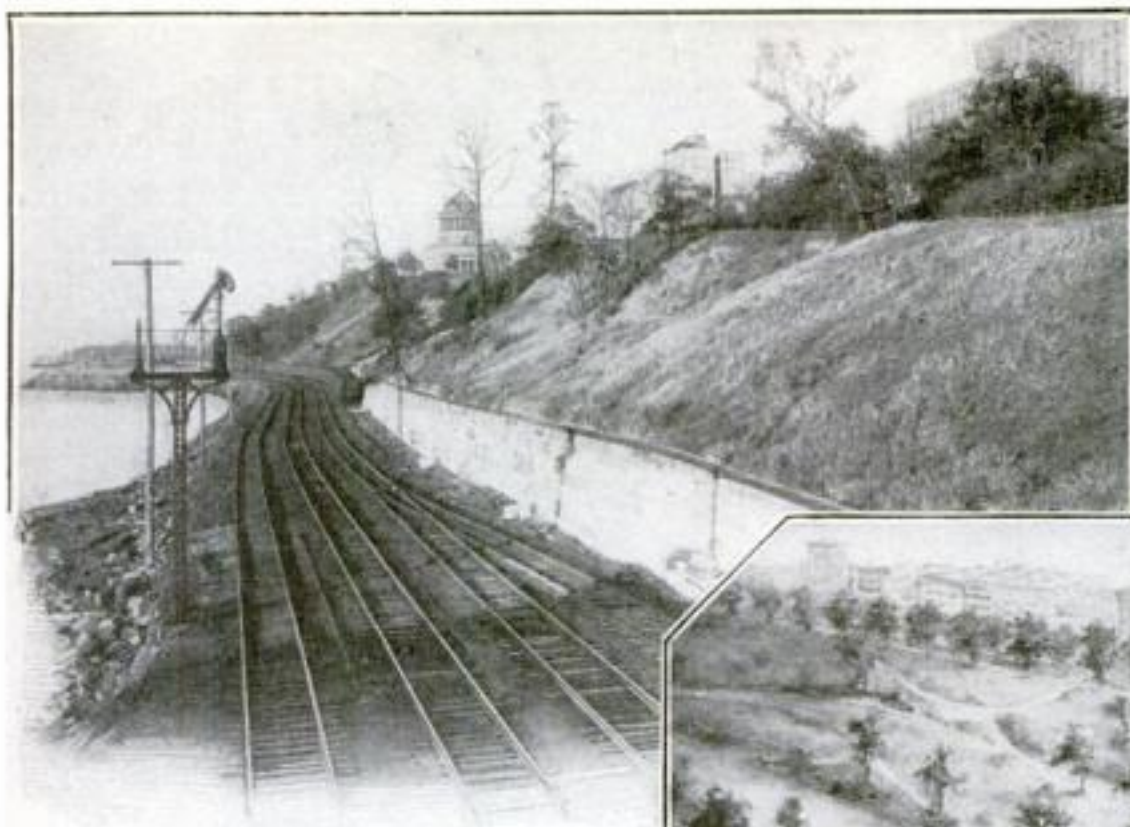


THE tiniest deer in the world have none of the grace and beauty of their larger relatives. They have legs like sticks attached to bodies that have a strong resemblance to mice. Their name calls attention to this—"mouse deer."

The word for that in Ceylon, where the queer little beasts live, is "goton." Those shown in the picture were brought to Boston recently, from Ceylon. Three others of the family died during the long journey across the ocean.

Huge Dinosaur Is Transported by Small Electric Car

EVEN the dinosaur has to bow to modern methods. In the quiet halls of the American Museum of Natural History, in New York City, a little electric truck busily pulls a platform on which towers the skeleton of a monster millions of years old. Using compact electric power to haul the greatest example of prehistoric brute power, science bridges a gap too vast to be estimated.

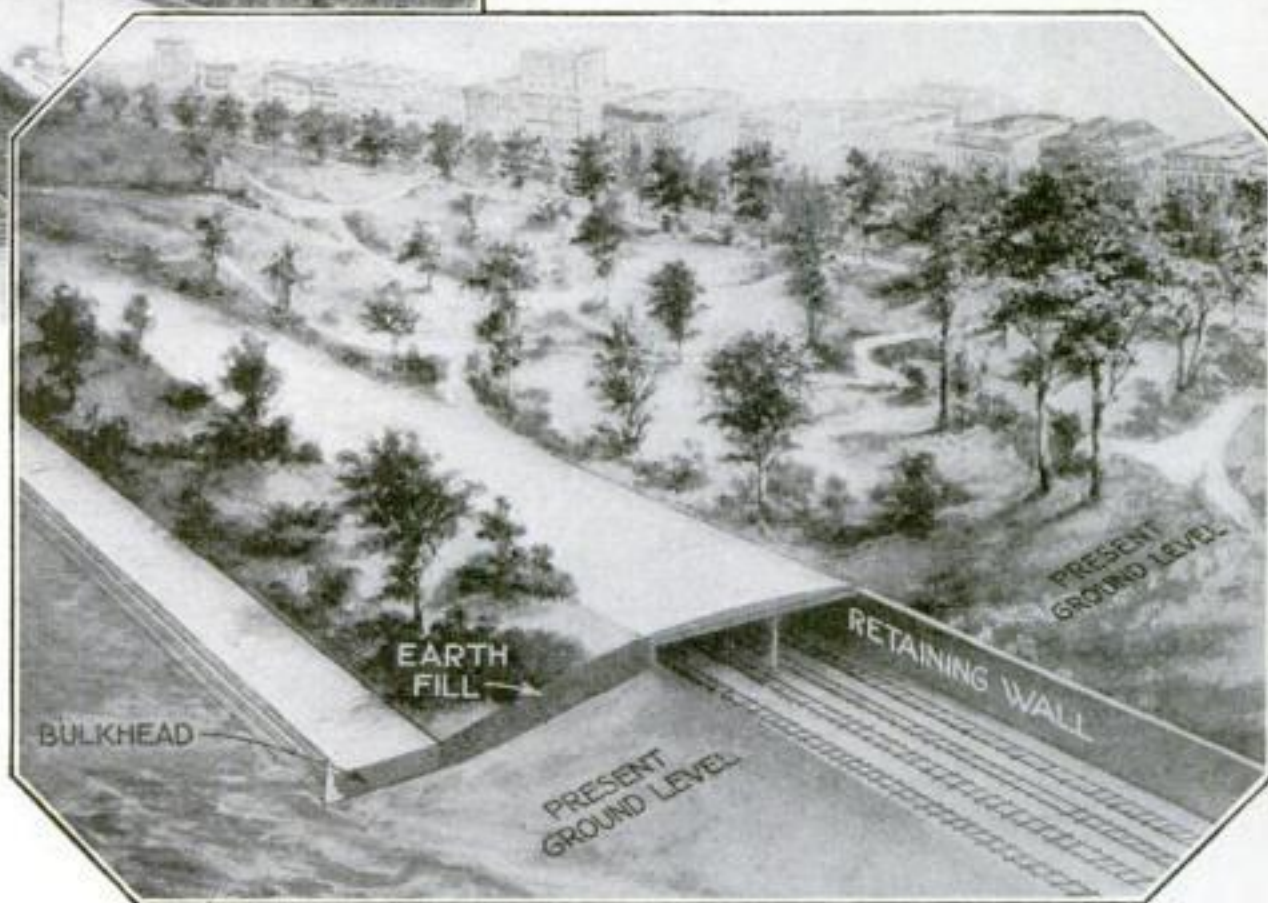


N. Y. Central tracks as they appear today

RIVERSIDE PARK, along the east bank of the Hudson River, one of the most attractive parks in New York City, has its beauty marred by railroad tracks, coal pockets, and garbage dumps at the water's edge.

An ingenious plan, introduced by Charles L. Craig, Comptroller of the city, would transform three miles of this unsightly water-front into playgrounds, a driveway, a promenade, and recreational centers, at the same time providing for the railroad, which cannot be pushed off Manhattan Island.

Land now under water, according to the plan would be reclaimed, in some cases extending the park 250 feet. A 25-foot promenade, for pedestrians only, with a sea wall, would extend the entire length of the new section. Back of this would be lawns and shade trees, with rest houses provided at convenient intervals, where people might sit and watch the passing steamers, or enjoy the view of the majestic Palisades on the opposite shore.



Architect's drawing shows transformation of tracks and water-front

The railroad tracks would be roofed over by a wide boulevard for automobiles. This would relieve part of the congestion on Riverside Drive, the street now above the park, and would speed up traffic, since the three-mile stretch would be broken by

only one crossing according to the plan.

The plan provides for 22 acres for play-lawns and tennis-courts. A fresh-water pool three blocks long would be provided, to be used in the summer as a swimming-pool and in the winter as a skating-rink.

Glass Dancing-Floor Is Lighted from Below

WHEN the moon is not shining, one still may dance under the stars at Biarritz, a popular French seaside resort. There, in the beautiful gardens of a pleasure club, a wonderful

glass floor illuminated from below gives all the light necessary for dancing.

The effect is attractive and the idea could be employed as a novelty in both indoor and outdoor dancing-rooms.



Lump of Seaweed Said to Be Millions of Years Old

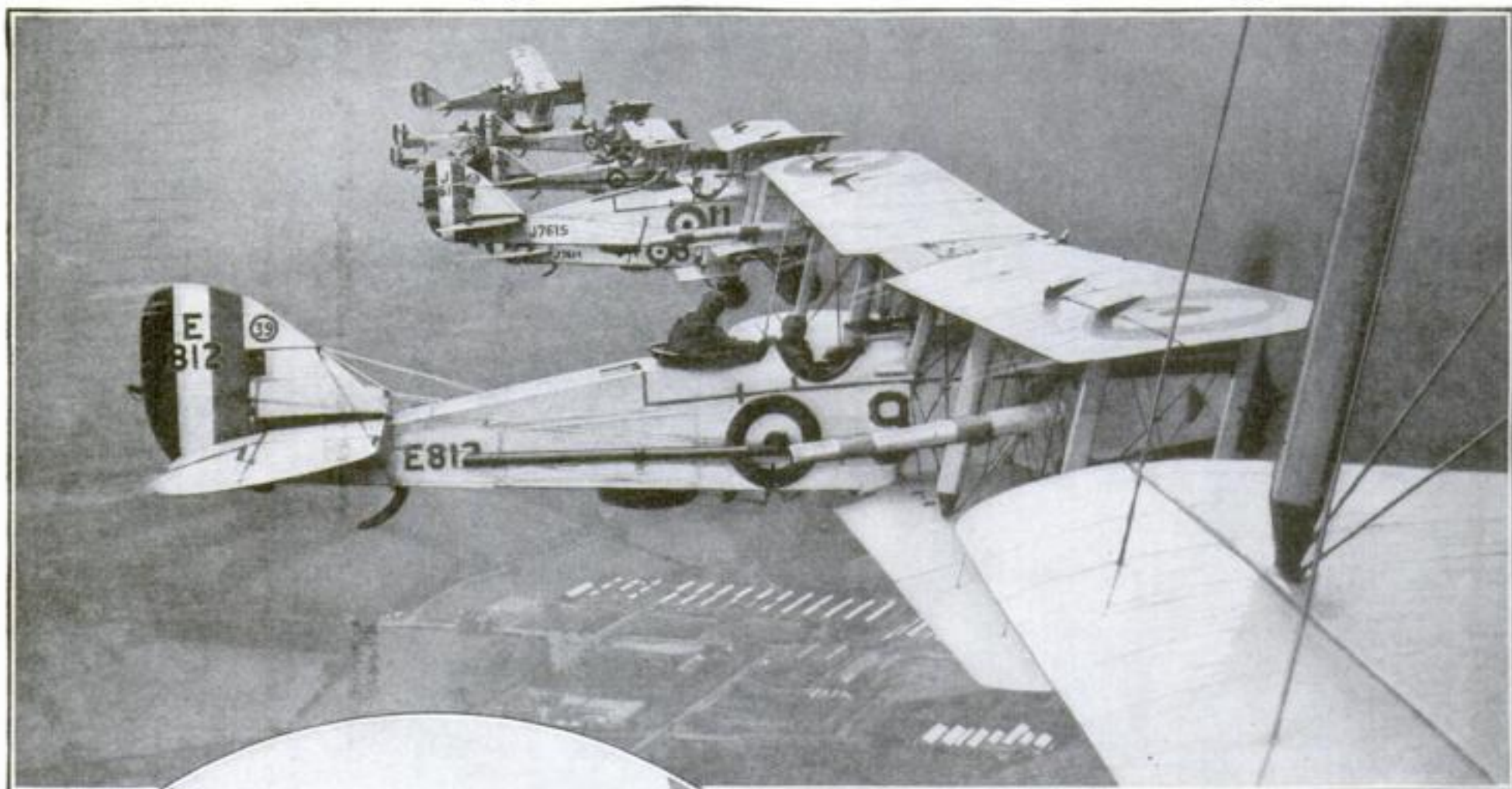
A 500-POUND lump of petrified seaweed discovered in the Medina sandstone of Pennsylvania, is believed to be 60 million years old. It was exhibited recently at the Department of Geology of the University of Pennsylvania by Dr. Frederick Ehrenfeld.

The structure of the sea plants can be seen very clearly in this unique rock, which is but another piece of evidence that the ocean once covered this part of our country.



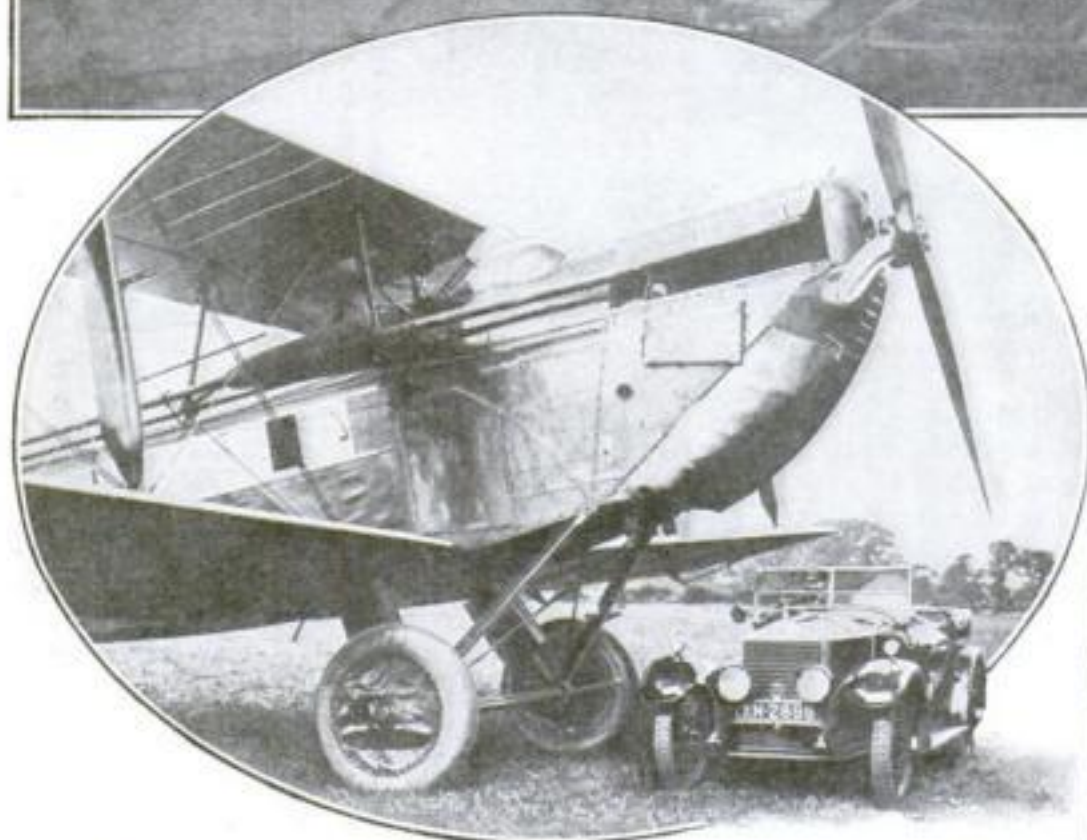
A fairylke scene at Biarritz, France, where lights shine through a glass dance floor

Sky Traffic and Its Progress



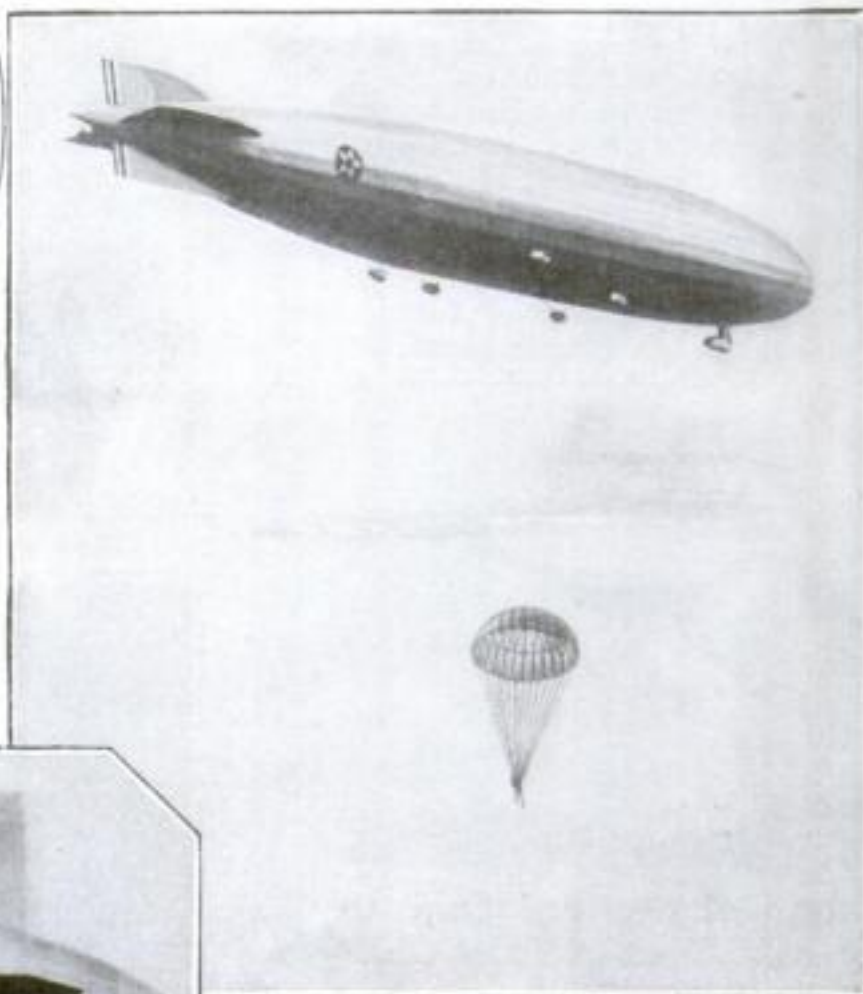
Battle Planes Fly Wing to Wing

One of the most effective maneuvers of the British Royal Air Force. Groups of planes swoop forward with breath-taking speed while maintaining an amazingly even formation.



Powerful British Plane Carries 16 Passengers

The most powerful single-engined plane in the world was shown at the Royal Air Force Meet recently in England. It is a DH-54 biplane, with a 650-horsepower engine. It will carry as many as 16 passengers, with baggage, at a speed of more than 110 miles an hour.

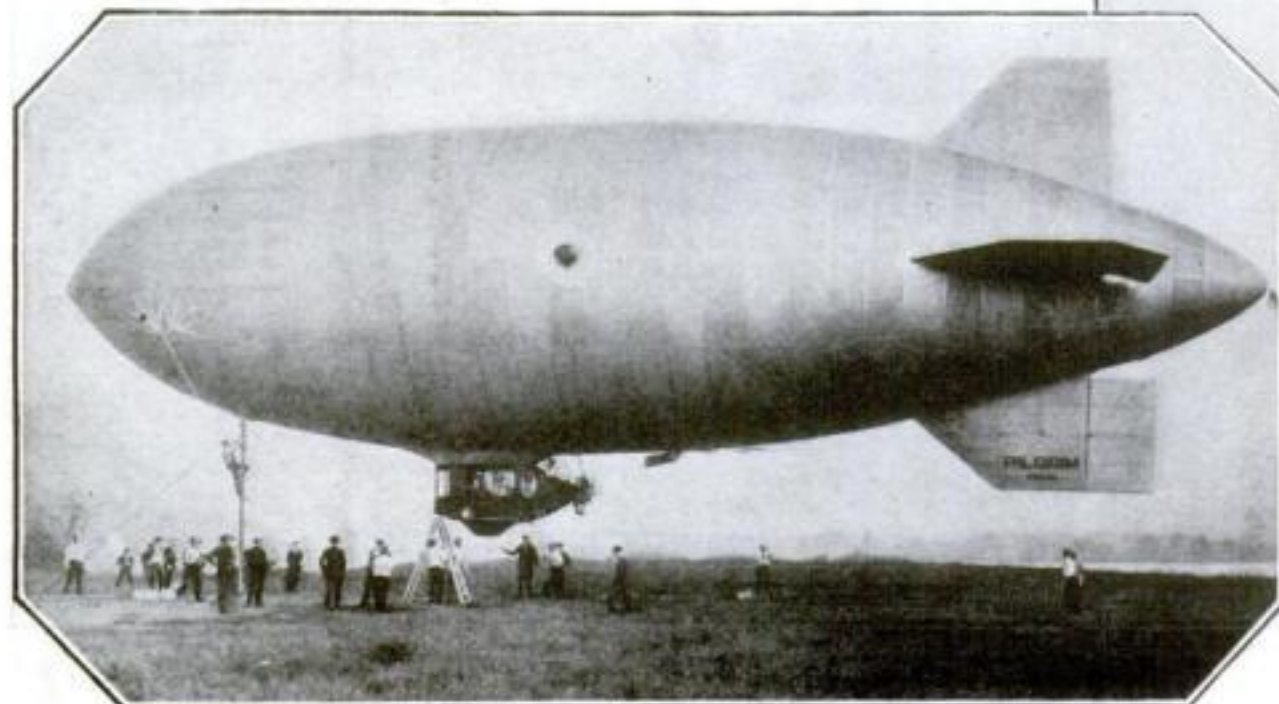


Jumps from a Dirigible

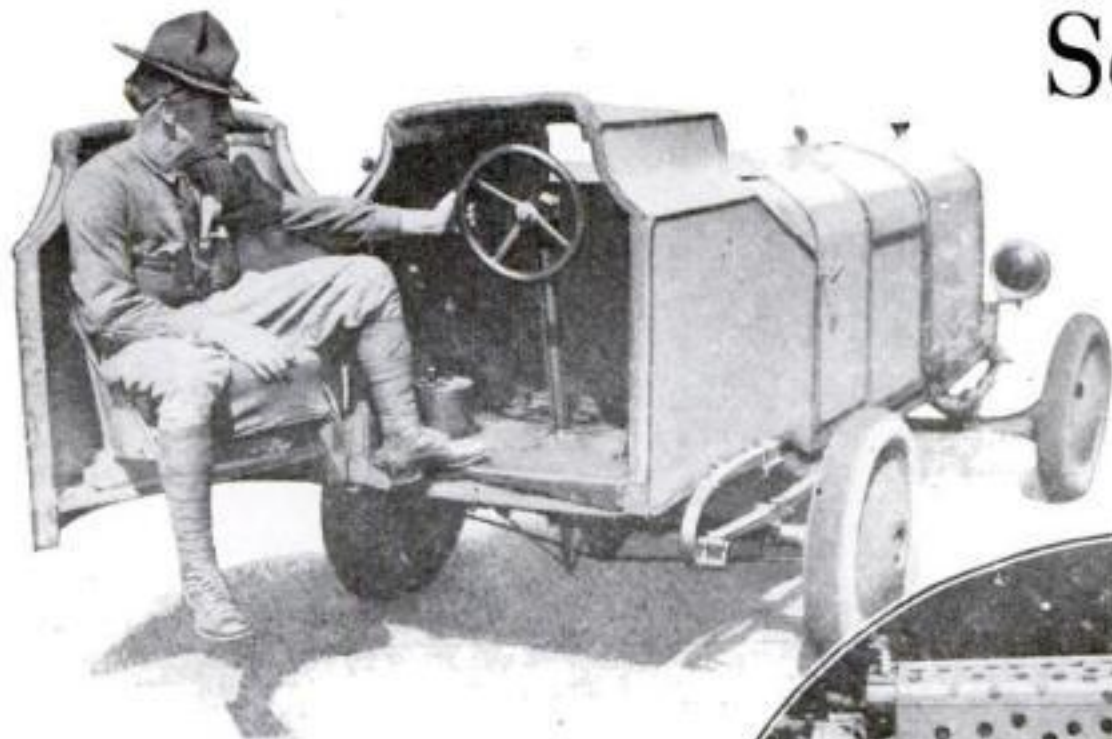
Parachute jumping from an airplane is not uncommon, but Lyman H. Ford recently jumped from the U. S. dirigible *Shenandoah*, when it had reached a height of 1500 feet, landing safely in a park.

The Smallest Airship

At Dayton, Ohio, for the first time a commercial airship was inflated with helium (left). It is 110 feet long, contains 50,000 feet of helium, the non-inflammable gas, and carries four persons.

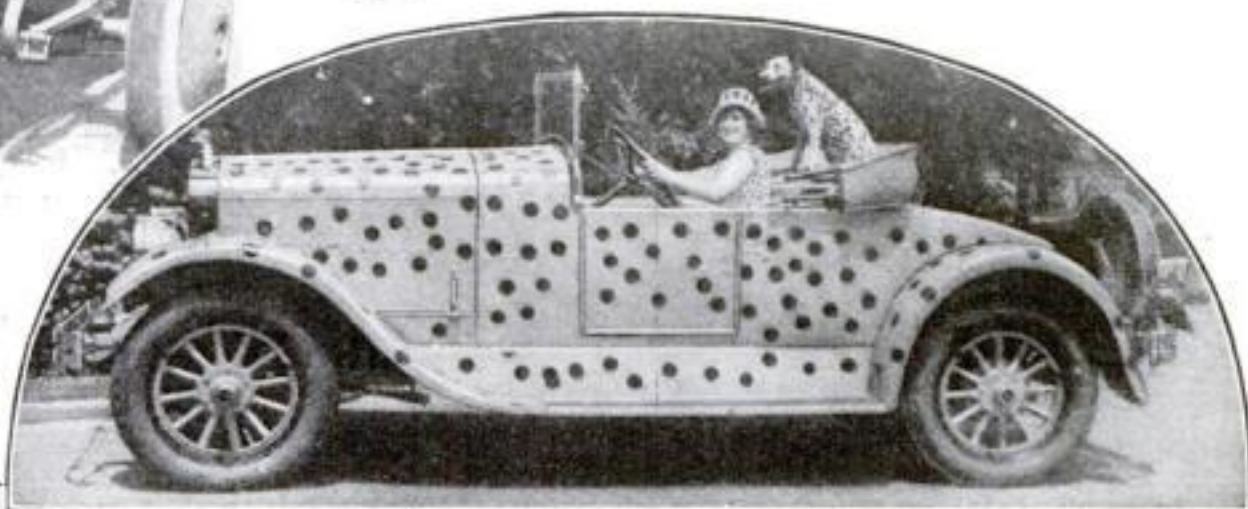


Some Curiosities *from the* Motor World

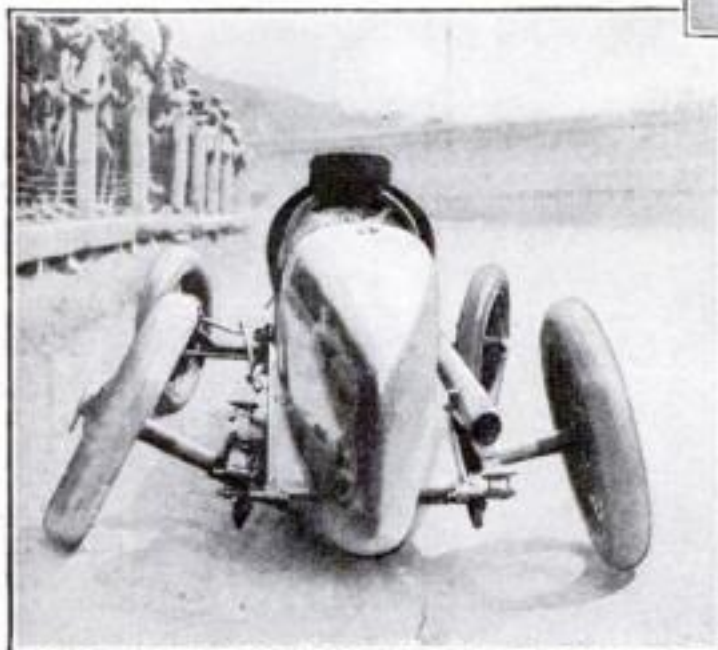


He Calls It an Automobile

This freak machine was built of airplane parts by a soldier at Mitchel Field, L. I. Driving and gear-shifting are done from the wheel. The driver's head sticks out as from an airplane cockpit when the door is shut



A Dalmatian dog is responsible for the photograph above. Miss Louise Hunter, of Atlanta, Ga., owns the dog, and his somewhat startling decorative scheme suggested the gown and the car, with the above result



Racer Breaks Rear Axle

A car driven at full speed by Leon Duray in a race at Altoona, Pa., recently, suddenly broke its rear axle and collapsed. This remarkable photograph shows the peculiar appearance of car after the accident



Quick Wit Saves Driver's Life

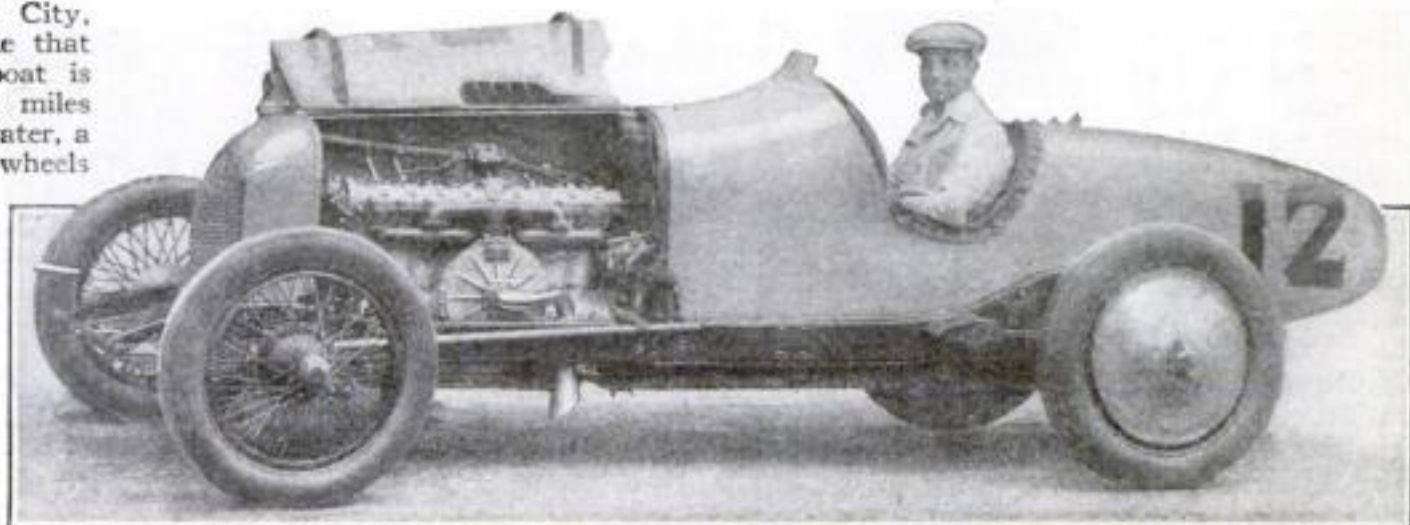
Quick thinking saved "Dick" Ryan, racing driver, from a terrible death. While driving on the track at Atlanta, Ga., his car caught fire. Ryan headed straight for the fence encircling the track, crashed through, and plunged into a lake below. He made his escape as the car hit the water, suffering only a few scratches about the face

A Three- Wheeled Automobile-Boat

Philip Matcovich, of Long Island City, N. Y., has invented an automobile that swims. On land the automobile-boat is said to have a 30-mile speed; 12 miles afloat. When the machine enters water, a rudder and propeller replace the rear wheels

A Champion Racer

Here is Peter DePaolo's winning racer fitted with the remarkable supercharger that forces air into the carburetor at high speed. Tests show that the new supercharger raised the pressure in the manifold about 11 pounds to the square inch





Newest Trousers Press Is a Camouflaged Chair Back

STORING a bulky trousers press has long been a problem to the well dressed man and the neat housewife. This particular problem has at last been solved, however, by an English manufacturer, who has hidden a press in the back of a bedroom chair. The bottom boards of the press form the actual chair back. Two boards hinged to the chair uprights form the top sections of the press.

The trousers are inserted, the top boards folded together, and the bottom lever is closed. A pull on the projecting part of the trousers stretches them, then the top lever of the press is closed.

Self-Feeding Shaving-Brush Carries Its Own Soap

PRESSING on the bottom of the handle of this unique shaving-brush injects sufficient cream into the bristles for a shave. The container, made of hard rubber and resembling an oilcan in shape, holds enough shaving-cream for two months' use.

The bristles are set in rubber and the brush is ornamented with a nickel plated cap.



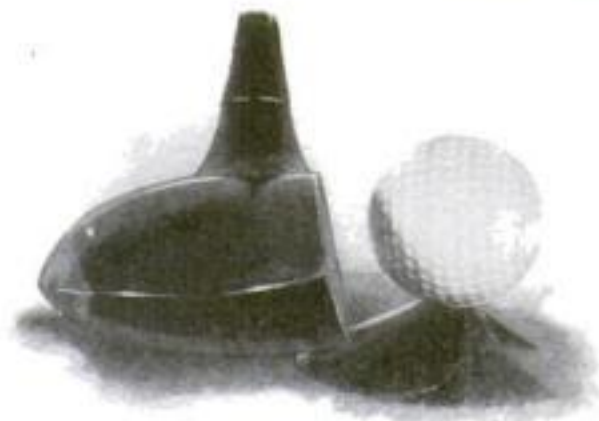
Pressure fills brush with shaving soap

THAT France secretly is building a large hydroplane with which it is hoped to fly the 4000 miles between Paris and New York without stopping, is a recent report from the French capital. The plane will have a motor of 550 horsepower and carry 1584 gallons of gasoline.

Makers of Collapsible Golf Tee Claim It Improves Stroke

UNDER hard driving the new type of golf tee illustrated at the right flattens out, then springs up in the same spot. This collapsible feature makes it impossible to injure a stroke, it is claimed, and the club head passes over the tee easier than it would on the gritty surface of an ordinary tee.

The tee is made of airplane cloth cemented between sheets of pyroxilin to give it resiliency and endurance.



No flying grit with new golf tee

INSECTS and grubs cause an annual loss of \$800,000,000 to the agricultural interests of the United States, and farmers,

fruit-growers, and gardeners pay another \$800,000,000 each year trying to get rid of these pests.

Frenchwoman Invents Painless Slaughter Gun

SLAUGHTERING cattle by hitting them on the head with an ax is needlessly cruel in the opinion of Madame Simon, founder of the French League for the Protection of Animals.

To replace this method she invented, recently, a revolver of large caliber that kills without a bullet.

A powerful explosive drives a four-inch spiked tube with terrific force into the brain of the beast. There is no trigger. The operator simply presses the barrel tight against the head of the animal and the spike is fired into the brain automatically. It afterward returns into the barrel.

The new weapon has been adopted for use by a Paris slaughter-house.



Humane slaughter gun and its inventor

\$33,000,000 for Buttons

IT MAY surprise the average individual to learn that there are two dozen or more buttons of various kinds on his suit of clothes. The value of buttons manufactured annually in the United States is more than \$33,000,000, according to the figures of the Department of Commerce.

Typist's Posture Improved by Novel Outfit

UNLESS she keeps it always in mind, a typist is apt to become round shouldered from sitting in a slouched position before her typewriter. While chairs made scientifically to fit the hollow of the back cause her to sit erect, still, she usually has to bend over to read her notes.

A new equipment fastened to the typist's desk helps her to sit erect at work without discomfort. A rest is provided for the feet, tilting the body back properly, while a notebook holder is supported above the typewriter at a good angle for reading.

Serums to Protect Stock

SERUM to inoculate stock against diseases, some of which never have made their appearance in this country, is kept in storage at Washington by the U. S. Department of Agriculture.



Typist's chair and table assure correct posture



Combination brush has convenient shape

Clothes and Hat Brush in One Is Handy for Traveling

HAT brush and clothes brush are combined in one handle in this new traveling accessory. The white brush is softer than the black one and made especially for brushing hats.

If the Pullman porter forgets the final touches before you leave the train, you yourself can get rid of the train dust with this brush that slips easily into your traveling-bag.

A TALKING wire that can be used by American business men to dictate letters or instructions across the Atlantic, or by means of which European radio fans can record entire programs broadcast in the

United States, is the result of 18 years of laboratory research by Dr. Kurt Stille, a German scientist. The apparatus resembles a desk telephone and is equipped with both transmitter and receiver.

Watch-Chain Safety Catch Foils Pickpocket

A UNIQUE watch-chain fastener, invented recently by George Stiegler of Cincinnati, Ohio, slides on the belt. The cross bar of a watch-chain slips under a raised part of the fastener, and lies next to the belt.

The same chain used when the watch is worn in the vest, thus can be used when the watch is carried in a trousers' pocket. The fastener is adaptable for all styles of chains.

New "Invisible Light" Renders Opaque Objects Transparent

BY MEANS of "invisible light" that he recently perfected, Sir Jagadis Chandra Bose, a distinguished scientist of India, in a recent demonstration before a group of scientists, proved that a heavy book can be made transparent. The light, called "super-retina," consists of short electric waves having the same properties as a beam of light. These waves are absorbed selectively by different substances. Coal-tar pitch is among the objects that it renders transparent, while water, on the other hand, is made opaque. Sir Jagadis claims that plants can perceive these invisible beams, though human beings cannot. He perfected his instrument after 30 years.



Simple catch secures watch-chain

Surgeon Signs Operation

A NEW practice has started among surgeons of signing operations. Dr. Evan O'Neil Kane, of Kane, Pa., marked a patient's skin with a small amount of India ink in radio code alphabet. Doctor Kane believes that a code could be arranged among surgeons for use in emergency operations, when a patient is unable to tell of previous operations that he has undergone.

Device Eliminates Movie-Camera Grinding

Movie camera is operated by pressure of a single button



GRINDING movie cameras by hand will be a thing of the past when the new motor control, invented by Arthur Todd, motion-picture cameraman, is universally adopted.

The new device, which is expected to revolutionize the art of cinematography, already is being used in the studios of Hollywood. Instead of the old hand-organ technic, all the cameraman has to do now is press a button that controls the motor, and the film travels.

The photograph at the left shows the cameraman in the act of starting the machine by the new method of simply pressing a button.

WITH a three-hour handicap a homing pigeon recently won a race against an airplane, flying between Paris and Brussels, 170 miles, in four hours.



Hang Moth Balls in Clothes by Means of New Spiral Holder

MOTH balls in a handy spiral container shaped like a spring can be hung inside a coat on a clothes-hanger, or hung on the door-jambs or hooks in a closet to make the whole closet moth-proof. This is also a good way of placing the balls in blankets or clothes stored in boxes or trunks, as it simplifies their removal when the articles are needed for use in a hurry.

LATEST reports from the U. S. Patent Office, through Patent Commissioner Robertson, show that applications for patents are granted now in about two, or not longer than five, months. Commissioner Robertson reports that in 1923 there were 72,475 applications pending. A year later the number was 59,000, and at the end of the fiscal year of 1925 only 43,000.

Toothbrush Holder Acts as a Constant Sterilizer



Sterilizing tube for toothbrush

WHEN toothbrushes get too dry, they become harsh and stiff and the bristles irritate the gums. A new tube for the brush keeps it at the right temperature, preventing this.

On the bottom of the tube is a cotton pad saturated with a medicated solution that sterilizes the brush between each using.

How Uncle Sam Killed Gophers

GOPHERS burrowing in the army landing-fields of the U. S. Naval Air Station at San Diego, Calif., so undermined them that they were causing serious accidents to landing planes. An appeal was made to the U. S. Department of Agriculture, which prescribed that poison be poured in the gopher holes and the mounds leveled with a steam-roller. This practically cleared the landing-field of rodents.

Compact Outfit for Replating Silver at Home



Negative and positive wires are adjusted and the plating pad does the work.

THERE is a compact home outfit for replating silver by which the metal is rubbed on with a pad.

The negative terminal is fastened to the article to be plated. The positive wire leads to the plating pad, a fabric container holding a dry composition of acids and finely powdered silver or other pure metal.

After being soaked in water, the pad is passed slowly over the surface to be plated. When the moist pad touches the article, the circuit is completed and the metal deposited.

The wiping action is said to have a burnishing effect so that no oxidation occurs. Thus it is possible to electroplate iron without a copper coating.

Playful Porpoises Sacrificed to Needs of Watchmakers

OBSERVING schools of porpoises sporting about in the water, few ocean travelers are aware that these strange animals have supplied them with an important product. The watches ticking in their pockets probably are lubricated with porpoise oil.

Oil for timepieces must answer very exacting requirements, among them, insensitiveness to heat and cold. At night watches are exposed to chill air after having been carried close to the body all day. The oil must not thicken or congeal on account of this change of temperature.

That extracted from the jaw pans of porpoises is said to be unsurpassed for lubricating watches. With the large increase in watch factories in the United States, porpoise-fishing has become an important industry all along the Atlantic coastline.

No Inflation in These New, Unsinkable Bathing-Suits



YOU may be a perfect duffer in the water, not know how to swim a stroke, and yet go with safety beyond the six-foot line. That is, if you have on a non-sinkable bathing-suit, designed for the person who cannot learn to swim, and that keeps him afloat and gives him confidence.

These new suits, said to have been

Houses Built of Steel, Cork, and Concrete

HOUSES made of cork on steel frames are the latest type of structure built in England, where great efforts are being made to plan houses that can be built rapidly by unskilled labor.

Slabs of compressed cork two inches in thickness are placed on a steel framework and this is inclosed in concrete, which is applied with a cement gun. The cork insulates against dampness, heat, and cold, serving the same purpose as air spaces in concrete or brick houses.



Concrete is sprayed on cork-covered steel-frame houses.

tried out successfully at beaches near Washington, D. C., recently, are made in one piece, fastening down the front. They are not inflated, but are made of light, non-sinkable material.

WHEN your fountain pen runs dry and you have no ink, usually you can obtain a supply of writing fluid by filling the tube half full with water. As a rule, there are enough ink crystals in the tube to make a fairly good writing fluid.

Pocket Camera Has 100-Film Roll

ONE hundred snapshots can be made with this minute "vest-pocket" camera with a single loading. It is not much

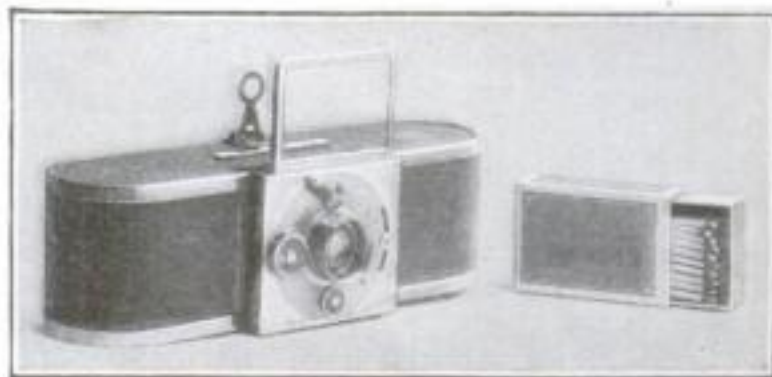
larger than a box of Swedish safety matches and takes a special roll of film, much like a motion-picture film, without the side perforations.

It will take views either from the horizontal position or from the vertical. The exposure speeds range from one second to 1/3000 second. By a special system of ratchets on the film spool, the film unrolls for only one view at a time when the pictures are being taken.

Malaria Inoculations Cure N. Y. Paresis Victims

THIRTY patients in a New York hospital, once believed hopelessly insane, are back at work, leading normal lives, cured by having been infected with malaria germs. The astounding method of curing a mental disease by inflicting the patient with another disease is meeting with marked success, according to reports issued recently from the Long Island College Hospital.

The malaria method of treating paresis, always considered an incurable disease, was originated in Austria. Malaria germs are injected into the veins of the insane person. After from seven to 14 days, when fever develops, it is broken with quinine and, following this, salvarsan is administered. Just how the malaria works to combat paresis is a mystery.



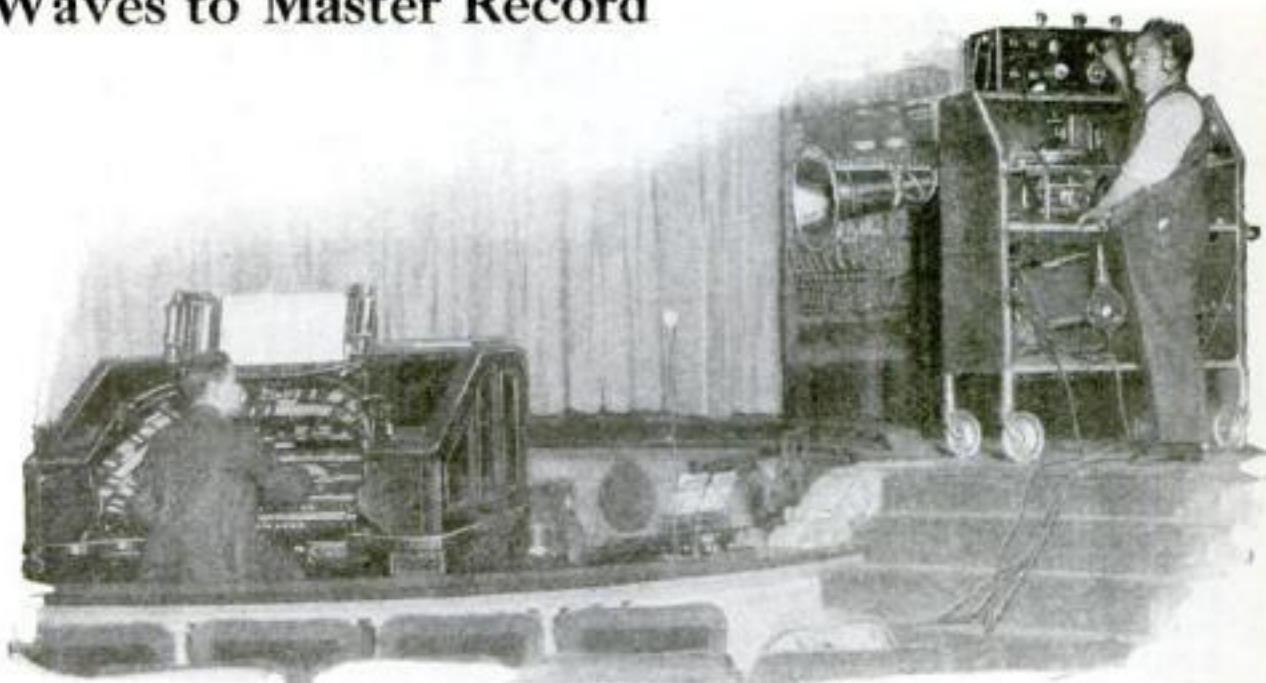
New pocket camera that holds 100-film roll contrasted with a matchbox to give an approximate idea of size

Device Controls Sound Waves to Master Record

INSTEAD of having the artist speak, sing, or play directly into the horn, this new invention uses electricity to convey the sound waves to the wax record on which they are recorded for the making of phonograph records.

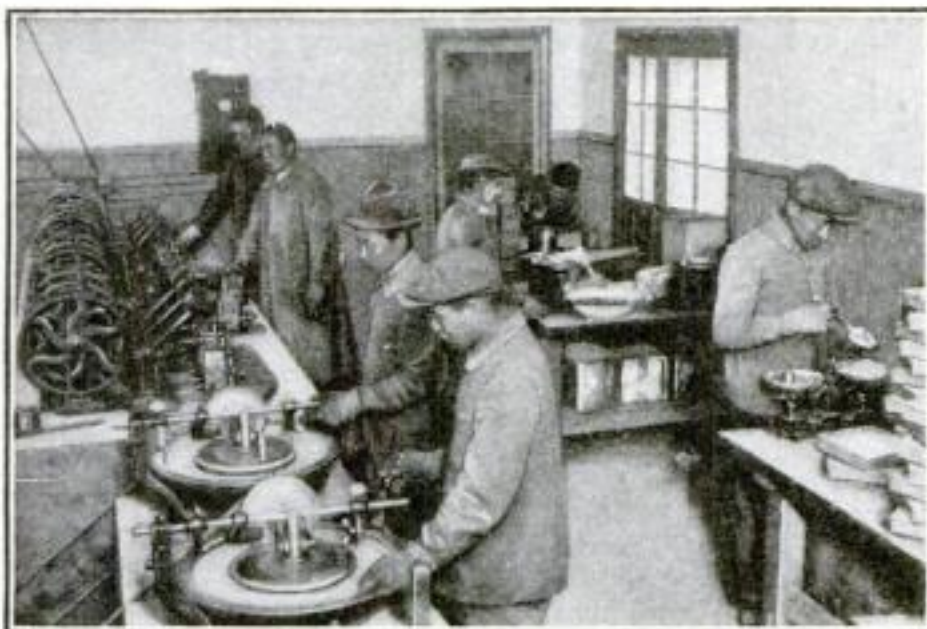
The desired tone can be obtained by the use of this device as the sound is regulated by electrical control. Orlando R. Marsh, of Chicago, is the inventor. He is shown in the picture recording an organ number.

A NEW motor alcohol made from molasses and the juice of the sugar palm is said to make starting easy and eliminate knocking and carbon troubles. Its disadvantage is the cost of making it, but extensive experiments are being made in Hawaii to overcome this.



Sound waves enter horn at whatever strength is desired by operator of new control

Japan Guarding against Future Earthquakes



A corner of Tokio's recently organized Bureau of Standards

IN REBUILDING their great city of Tokio, destroyed by earthquake, the Japanese are taking the utmost care to get nothing but good materials. A testing bureau has been established, somewhat like our government Bureau of Standards. The new buildings in Japan's capital will be far different from those of wood and paper that fluttered to the ground in the last great disaster, it is certain.

Hats Are Made to Fit with a Self-Adjusting Silk Pad

EXACTLY how many hats have been thrown away on account of bobbed heads has not been estimated, but they number in tens of thousands. Old hats will not fit with the wearer's hair cut off.

To make large head sizes smaller to fit smaller heads, a new hat size-reducer has been put on the market. It is a narrow silk-covered pad, which is pressed into place with three small prongs, requiring no sewing or adjusting.



How the hatband is adjusted to reduce head size, and the band itself

TO REST the diseased lung of a tuberculosis patient, a British inventor has produced a machine which pumps air into the thoracic cavity by way of a hollow needle inserted between the patient's ribs.

Births Now Exceeding Deaths in the United States

ALTHOUGH the population of the United States is now at the high-water mark of 114,311,000 people, the advance over last year was less than the average for the last five years, according to recent estimates of the National Bureau of Economic Research. The once rapid advance, it is believed, has now definitely slowed up.

That the regular increase in the population has not been due to immigration, but to the excess of births over deaths, is shown by figures covering the last 16 years. In that period there were more than 41 million births and about 22 million deaths, or an excess of 19 million births. About 5½ million were added by immigration, bringing the total increase to about 24 million. Of this number, immigrants formed little more than a fifth.

Ten years ago the birth rate was 26.2 for each thousand persons, while today it is 23.3. At the same time the death rate has decreased from 13.4 to 11.7.

Alabama to Have World's Largest Artificial Lake

WHAT will be the largest artificial lake in the world, is being built in a remote section of Alabama to assure a constant flow of water for driving three large electric generators. These will feed power into the electrical transmission system of the state.

With the exception of those at Niagara Falls, the three 45,000-horsepower water-wheel-driven generators will be the largest in the United States. The artificial lake will have a shore line 700 miles long and will cover 40,000 acres of farm and forest land. Agricultural experts believe that the construction of the huge lake will make a vast section of the country to the south of the lake frostproof and advantageous for fruit-growing.

Man Sails 202 Miles Down the Mississippi on a Mattress



IF YOU want to take an inexpensive trip, think over the possibilities in your own home in the way of water craft. You might make a raft of the dining-room table, or, there are the mattresses.

Sidney Helms, of Des Moines, Ia., had an idea that he could negotiate the 202 miles of Mississippi River between his home and St. Louis on an ordinary mattress. Friends laughed at him, but he tacked the mattress to a light frame and added an outboard motor.

The photograph above shows Mr. Helms' arrival at St. Louis.

Modern Utensils *for*

*On These Pages the Expert Housewife
the Labor of Every-Day Tasks and*



Five Tools in One

For window-box gardening a new set of five gardening tools, used with a single handle, is a decided convenience. The set may be stored away in very little space and yet every sort of tool likely to be needed in such work is available.

A Knife-Sharpener

A tool for sharpening any shape blade is screwed to table or wall. Twin grinding wheels of fine corundum are held together by a pressure spring. When being sharpened, the knife blade rests in a beveled groove.

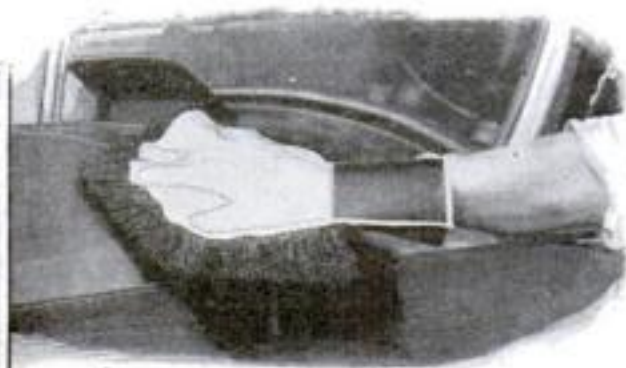


New Washing Machine

Specially built for apartment use, this new washing machine stands on one leg and is held by two rubber-covered hooks to the edge of the sink, laundry tub, or bathtub. It is run by water power. Washing, rinsing, bluing, and drying all are done without removing the clothes from the machine.

Electric Doughnut Frier

Doughnuts can be fried by electricity by putting this electric plate inside your doughnut kettle. The heated grease circulates through the holes of the plate, which is so wired that an even temperature is maintained. The plates are made in several sizes to fit standard kettles.



Duster Glove with Cuff

A duster in the shape of a large glove is made to fit either hand and has a long cuff that protects waist or shirt. Grease does not penetrate the glove so that a person with a cut or bruised hand is protected from possible infection while using the duster.

Three-in-One Kitchen Tool

Orange juice may be prepared in a jiffy with this little combination household machine. Besides extracting juice, it will beat eggs and sharpen kitchen and table knives.



Special Brush for Glasses

Often it is difficult to get the inside of a glass clean, especially after fruit drinks. The round brush shown at right will do a thorough job of cleansing any tumbler.

Automatic Pancake Turner

At first sight the pancake turner below looks like any other, but it is equipped with a spring that, when pressed, turns a pancake without any effort whatever.



the Up-to-Date Home

*Will Find Valuable Suggestions for Easing
Reducing Their Drudgery to a Minimum*



Single-Burner Top Oven

The useful and economical oven shown above bakes over a single burner on a gas, oil, or electric stove. For kitchenettes or camps, where space and heat must be considered, it will be found especially useful.

Mop and Wringer

A simple twisting motion forces water to the surface of the mop and a metal squeegee rubs it off. The mop has no wooden roller to get out of order and will wring out any soft material.



Small Vacuum Cleaner

This little hand electric vacuum cleaner is a complete machine in itself and with the auxiliary dustbag weighs less than three pounds. It may be attached to a light plug.



Bottle Cover and Opener

The combination milk-bottle cover and opener shown at the left is made of metal. The pointed projection on the cover removes cap easily.

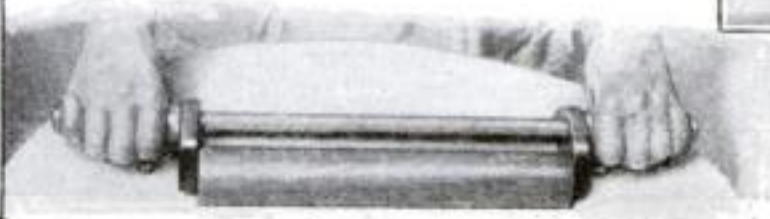


Sealer Straightens Caps

A new fruit-jar sealer fits over the top of a screw cap. Damaged caps can be used, since the sealer straightens out the edge and prevents leaks.

A Double Rolling-Pin

In this double rolling-pin, one roller, directly back of the other, smooths out any bumps in piecrust or noodles left by the first roller as it passes over them.



Kettle Lights Gas-Ring

A gas-burner that lights when a kettle is put over it and goes out automatically when the kettle is removed is a new economy device for the kitchen. When the kettle is off, a small pilot light remains burning.

Reminder Clock for Cooks

When it is time to take the cake out of the oven, an alarm-clock goes off. A little knob in the lower right-hand corner sets the dial for time desired.



Vegetable Cooker and Drainer

Vegetables are cooked in a wire basket that rests in a new type of cooking-pot. After the water has been drained off, the basket is whirled by turning a handle on the pot cover. This leaves the vegetables dry.



Milwaukee man carves oak replica of da Vinci's famous picture

Ingenious New Sun Clock Comes from Australia

A NEW kind of sun-dial that tells time within 30 seconds of an ordinary clock, has been invented by an astronomer in Australia. It consists of a ring that can move on pivots placed in a north and south plane.

On one side of the ring is a small hole, which, when the sun is shining, casts a small spot of light on a figure 8 on the opposite side. This curve is marked with the date for various times of the year and allows for the amount that the sun is ahead or behind its average position.

The ring is turned until the spot of light is on the proper part of the curve and the hands, which are geared to it, then indicate the correct time.

Know Your Car

THE linings of most automobile brakes wear out long before they should, simply because they are used too much. Traffic emergencies arise, of course, where a sudden and strong application of the brakes is absolutely necessary. In ordinary driving, however, the use of the brakes should be avoided whenever possible. Instead of keeping your foot on the throttle until the last minute, then jamming the brakes, shut off the power in advance, so that the car will slow down gradually with just a touch of the brake.

Brakes will last much longer if five simple rules are followed:

- 1—Coast to a stop instead of jamming on the brakes.
- 2—Throw car into second speed at the top of long, steep hills, and let the drag of the engine serve to retard the speed of the car instead of the brakes.
- 3—Keep mud and grit out of the brake linings.
- 4—Wash the brake linings with gasoline if oil leaks out on them.
- 5—When you renew the brake linings, be sure to polish the brake drums with fine emery paper if they become roughened.



Warning Traffic Signal Is Built like Speedometer

A UNIQUE warning signal made to resemble an automobile speedometer warns motorists in St. Louis of the seriousness of careless driving. At the top, where the mileage figures usually go, is the number of deaths from motor accidents that occurred the day before.

Beneath that, in the place where mileage usually is recorded, are the number of total deaths for the past week and total deaths for the year. A sign below gives the total of motor deaths during the same period a year before. Signs radiating from the "speedometer" give bits of advice.

THERE is little, if any, difference in the tastes of negroes and white persons so far as colors are concerned, as determined in tests made recently by Miss Florence Mercer of Texas Women's College. Examining more than 1000 negroes in Texas public schools, she found that children in the first and second grades preferred red, with blue, green, and violet following in order. This preference changed through the grades until the eighth-grade pupils named blue as their favorite color with red liked least of all. White school children tested showed the same results.

A Picture Copied in Wood

FROM a slab of solid oak, August Eberhart, of Milwaukee, Wis., recently completed a remarkable copy of da Vinci's "The Last Supper."

Great delicacy and fineness of detail in the work make it distinctive. Mr. Eberhart achieved an almost cameo effect although working with a slab of the hard wood 40 inches long and seven inches thick.

Mr. Eberhart, shown in the photograph with his work, learned wood-carving when he was only 14 years old.

A CARILLON of bells in Bruges, Belgium, is famed throughout the world, so it is no mean commendation when a carillon for America is likened to it. The latter chimes consist of 53 bells, to be erected in the Park Avenue Baptist Church of New York City, the gift of John D. Rockefeller. The carillonneur of Antwerp Cathedral has been engaged permanently to play them in New York.

Sisters Talk to Each Other across 150 Miles of Sea

A WOMAN on an Atlantic liner called up her sister on another ship 150 miles away, recently, and the two carried on a conversation lasting eight minutes. This was the first trial of a new marvel—a wireless telephone invented in Germany that can be used either between two ships or between a ship and land.

Previously, messages could be spoken only one way over wireless telephones. Only when the speaker had finished and the receiving antennae had been switched on, could a person at the other end reply. Now messages may be spoken both ways simultaneously and interchangeably.

Home Fire-Gong Gives Alarm at 120 Degrees of Heat

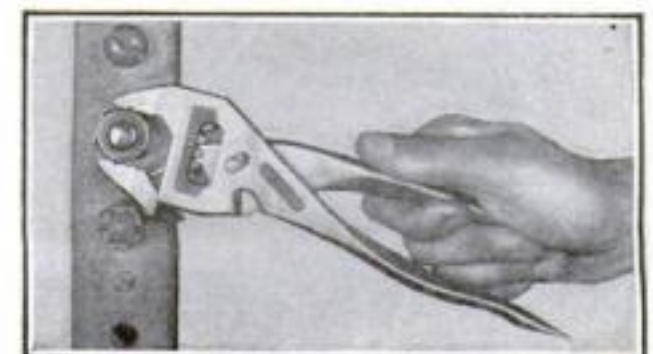
THIS little mechanical device requires no attention, and has no electrical connections. It is a fire alarm for the home. When the temperature in its vicinity is raised to 120 degrees, a fuse melts and releases the small gong, which rings for some time.



Showing key that winds fire alarm

Pliers with Three Grips

IT IS said that these novel pliers can exert more gripping force on odd shaped surfaces than is obtainable with any other type of hand tool. A combination of geared and cam leverage is responsible for this strength. The pliers has a special pipe jaw and a round-nosed jaw that can be substituted instantly for the standard jaw for certain kinds of work.



Pliers grip nut with unusual strength

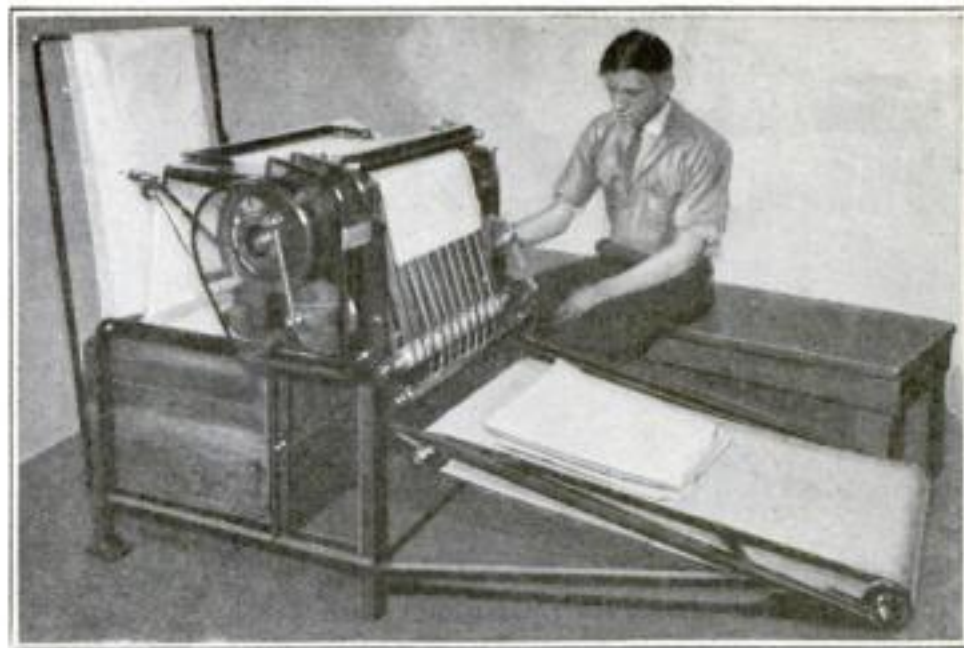
Ingenious Handkerchief-Cutter

AN AUTOMATIC handkerchief-cutter, taking up only 15 square feet of floor space, less than a tenth needed for the ordinary machine used for this purpose, is the invention of Max Schleifer of Newark, N. J. For half a century the handkerchief industry has been seeking to perfect a small practical machine of this type.

The new machine will measure, cut, assemble, and count 200 dozen handkerchiefs an hour, 50 dozen more than the machines now in use. It stops automatically if the supply of material runs out or defects occur in the material. This automatic action enables one boy to operate three machines.

Any size handkerchief from six to 20 inches square may be cut. The machine rollers adjust the material so that the machine is said to cut straighter lines than a man can, using a knife.

RECENT researches with fowls have shown that the quantity of grit carried ordinarily in the gizzard of a chicken is sufficient for a year's use, supposing the chicken could get no more.



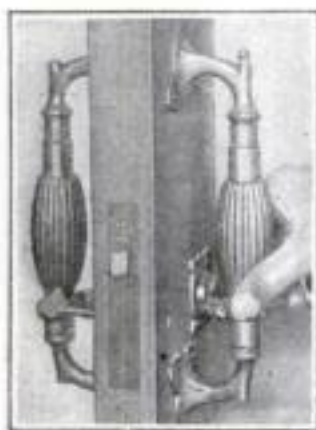
Machine measures, cuts, assembles, and counts handkerchiefs

American Establishes Figures for Earth's Diameters

AN AMERICAN scientist has determined the earth's diameters so accurately that his figures have been adopted by all countries. Director John F. Hayford, head of Northwestern University College of Engineering at Chicago, is responsible for this triumph.

The diameter is 7,926,678 miles at the equator, while the diameter from pole to pole is 7,899,964 miles, proving the earth to be a sphere flattened at the poles. Director Hayford's figures will be the basis of every boundary survey in the world in the future.

New Safety Door Lock Is Made without Use of Springs



Ordinary key lifts the safety bolt

A NEW springless device keeps a door locked automatically. The door can be opened from the inside by lifting a barrel-shaped piece that slides on the handle. This is loaded, keeping the bolt shot. A simple key locks the bolt.

Improved Clawhammer Ax Has Many Uses

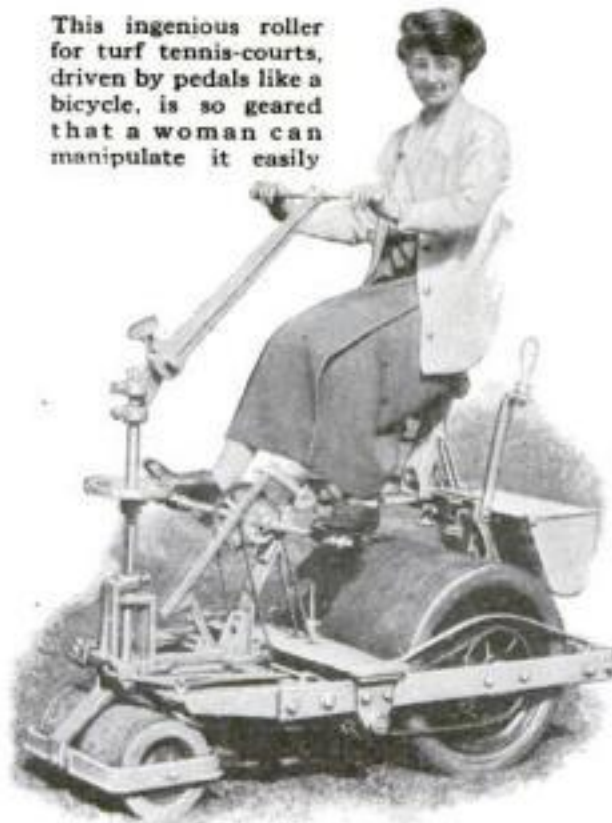
FOR the farm, camp, or store a handy new tool is a clawhammer ax. The claw is for pulling nails or for prying open boxes or crates.

The ax head may be used as a hammer or for pulling staples. The ax is forged solid and a wooden grip riveted securely to it so there is no danger of the head's flying off. The tool weighs only 28 ounces.



How the handle is riveted to the ax

This ingenious roller for turf tennis-courts, driven by pedals like a bicycle, is so geared that a woman can manipulate it easily



How the English Roll Their Lawns and Tennis-Courts

WHEN a turf tennis-court needs rolling, every fellow tries to shift the job to another. It's no fun, but real work, pushing a roller. A machine has been invented recently in England, that may induce even the girls to take a turn at rolling.

It is a combination bicycle-roller operated by pedaling. It is so geared that the effort ordinarily spent in running a bicycle pushes the machine about the court or lawn.

High-Pressure, Hot-Air Fan Dries Hay in Eight Hours

A FEW months ago POPULAR SCIENCE MONTHLY described a method that English farmers were using to dry hay artificially in the fields. Now the University of Wisconsin, on its experimental farm, is demonstrating a similar hot-air drying process.

By means of a high-pressure hot-air fan, new-mown hay was ready for baling eight hours after raking. Ordinarily, it would have taken two or three weeks of field drying, and the owner would have had to run the risk of moisture, damage, and pests. Twelve loads can be handled on the drying rack at one time.

Simple Distress Signal Code for Hunters and Explorers

A SPORTSMAN and big-game hunter, J. Allen Barrett, of Lykens, Pa., has copyrighted a unique idea for a national code of distress signals for persons who may be lost, injured, or in need of assistance while traveling or hunting in sparsely settled regions.

Revolver shots should be used for the signals, but the victim could shout, call, or whistle them. The chief requisite would be to have the code widely understood. The code follows:

To signify "lost," two shots quick; wait; one shot. "Injured," three shots quick; wait; one shot. "Sick," four shots quick; wait; one shot. "Help," two shots quick; wait; two shots. Rescuers answer, using the same number of shots, but in reverse order. The answer to "lost," for example, is one shot; wait; two shots quick.

How Much Do YOU Know about Science?

THE following questions are the kind that POPULAR SCIENCE MONTHLY receives daily. Look them over and see how many of them you can answer. Now turn to page 171 and see what percentage of the 12 questions you were able to answer correctly.

1. What colors the eyes?
2. Why does hot iron glow?
3. Why do we sometimes see a double image reflected in a window?
4. What causes quicksand?
5. Why must you use direct current in charging a storage battery?
6. Does the sun actually draw up water?
7. Why does space outside the earth remain cold, although the sun is shining through?
8. What are comets?
9. If the earth hit a comet, would there be any damage?
10. Why is it that a hurt received while you are excited is seldom felt until afterward?
11. What produced the Grand Canyon?
12. Why does a driftwood fire burn with such varied colors?

What Set Shall I Build?

*A Vital Problem of the Radio Fan
Who Constructs His Own Solved
by Receivers Designed for
Every Need*

By
Alfred
P.
Lane



Fig. 1. Complete POPULAR SCIENCE MONTHLY four-tube receiver—ideal for the fan who has had some experience in radio construction



Fig. 2. One-tube receiver and three-stage amplifier combined in one set—a highly efficient receiver for the beginner to tackle

THIS is the time of year when thousands of men and boys are turning from outdoor sports to consider the problem of what radio set to build. Large numbers of these already are radio fans. They have, perhaps, built several different radio receivers, and now they wish to rebuild their old sets or make up entirely new outfits in order to improve the distance or quality of their radio reception.

There are, also, many men to whom radio is still new and strange as far as the actual construction of a radio outfit is concerned.

On the surface the problem of what set to build seems simple enough, but unfortunately there are a number of factors to be taken into consideration which have an important bearing on whether the finished radio receiver, as constructed, will give the builder the type of service he expects.

Take, for instance, two typical cases. One is a man who lives in a large city, where there are several broadcasting stations. He wants good loudspeaker reception of local stations and cares little about distance. The other is a man who lives cut in the country, where the nearest broadcasting station may be 100 miles or more away. This man must have a set capable of getting distant stations.

A RECEIVER that will give perfect satisfaction to one of these men may, conceivably, be of no use to the other. And there are still other considerations if success is to be assured.

Ask yourself these questions: Is reception particularly good or bad in my vicinity? Is a long, high outdoor antenna possible, or must I depend on a short indoor one? Have I sufficient me-

chanical ability to build successfully a radio set? How much money can I afford to spend? Shall I be satisfied with head phones or must I have loudspeaker results?

Your answers to these questions have a vital bearing on your decision as to what radio set to build.

POPULAR SCIENCE MONTHLY has published, during the past six months, a number of designs for radio receivers that are particularly suitable for home construction. In each case a model receiver was constructed and tested by the Popular Science Institute of Standards before the article was written. Constructional details and the operation of each set were given, with a conservative estimate of the receptive qualities of the particular model being described.

Three of these radio outfits were considered to be of sufficiently universal appeal to warrant the publication of special blueprints giving details of their construction. And, although the articles

were published during the spring and summer months, when radio construction is at a low ebb, so many letters were received from interested readers that we have decided to discuss these sets again, so that if you now are contemplating the construction of a radio receiver, you will be able to decide which set is best adapted to your individual needs.

THE one-tube radio receiver illustrated in Fig. 5 on the opposite page (described completely in POPULAR SCIENCE MONTHLY for May, 1925, and shown in detail in Blueprint No. 41) is a simple, easy-to-build receiver possessing many advantages.

There are no moving coils and, consequently, the tuning unit can be wound in just a few minutes. Any standard type of tube may be used with excellent results. The reception is particularly free from distortion because no audio-frequency current is allowed to flow through the tickler coil and consequently regeneration can be forced almost

to the point of oscillation without any perceptible change in the tone quality.

Because of the simplicity of construction, this receiver is ideal for the man who is about to build his first radio set. At the same time it is so efficient and gives such good results in the reception of distant stations on the head phones, that it is ideal also for the man who does not wish to go to the expense of more than one tube.

Here is what one of our readers in Providence, R. I., writes us about this set:

"I have constructed the long-distance radio set that was described in the May number of POPULAR SCIENCE MONTHLY and feel highly gratified with results. It may interest you to know the stations I

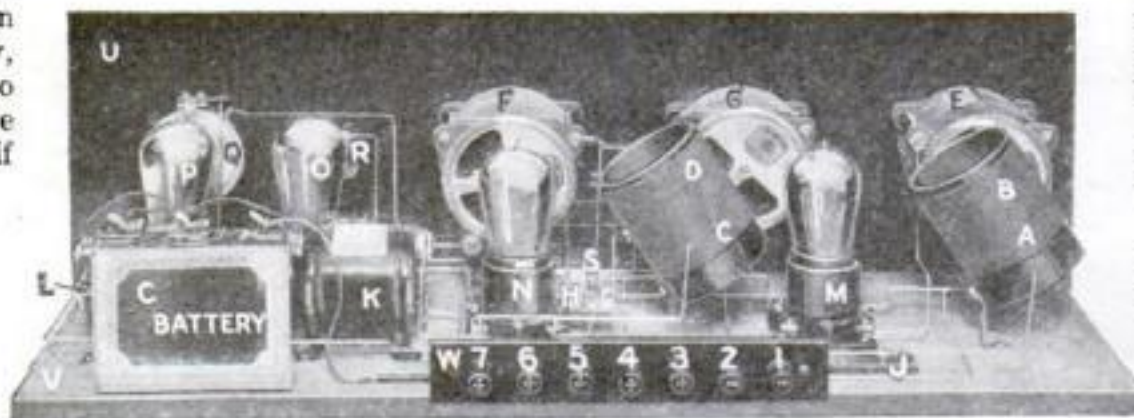
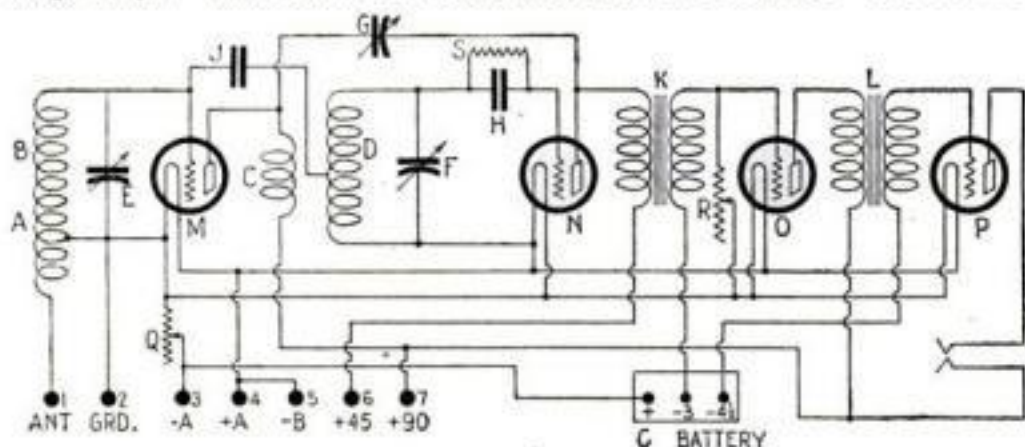


Fig. 3. Rear view of the four-tube receiver, described in detail in our July issue, showing layout of parts and wiring. The complete wiring diagram appears above. This set gives maximum long-distance reception with fine selectivity

logged the first few nights that I used the set were: WEAF, WEEI, WQJ, CNRO, WLW, WLIT, WTAM, WGY, WBZ, WSAI, WGBS, WAHG, KDKA, and several others."

And this is what another reader in Jersey City, N. J., writes about the one-tube set:

"The most pleasant feature of this circuit is that there seemed to be none of the terrific squealing or re-radiation generally found on the usual regenerative set. I might say that I have experimented with different types of regenerative outfits, but I heartily endorse this one to beat them all."

Another fan in Toronto, Canada, writes:

"I have completed your one-tube receiver as described in the May issue and have already received 55 different stations."

WHILE some of our readers have written that they have obtained loudspeaker volume with the one-tube set on local stations, such results can be obtained with one tube only when the broadcasting station is less than five miles away and the receiver is connected with a good outdoor antenna. The logical way to obtain loudspeaker volume is to build a good audio amplifier and connect it with the one-tube receiver. Such an amplifier is illustrated in Fig. 4 (described completely in POPULAR SCIENCE MONTHLY for June, 1925, and shown in detail in Blueprint No. 42).

Large numbers of radio fans who built the one-tube receiver since have added the amplifier. A radio constructor from Los Angeles, Calif., writes:

"I made the one-tube set you published in the May issue and will say it is the best one-tube set I have met with and now I want to make the coupled resistance amplifier and will ask you where the variable resistance unit for panel mounting is to be had."

This amplifier unit has three features of particular importance: First, it is extremely easy to assemble and wire. Second, it reproduces with remarkable quality and clearness, and third, it will not squeal or howl, provided that

Blueprints Available

DETAILED working blueprints for the construction of the three radio units discussed on these pages are available, and will be found listed among the POPULAR SCIENCE MONTHLY blueprints on page 87 of this issue. Blueprint No. 41 is for the one-tube receiver shown in Fig. 5; No. 42 for the amplifier unit shown in Fig. 4; No. 43 for the four-tube receiver shown in Fig. 3.

all the connections are made correctly.

When the one-tube receiver and the audio amplifier are combined, as shown in Fig. 2, at top of previous page, they will bring in stations and put them on the loudspeaker in a way that will satisfy most radio fans completely. This is true only when a good outdoor antenna can be used.

MANY readers have asked what advantage there would be in building the four-tube receiver illustrated in Figs. 1 and 3 (described completely in POPULAR SCIENCE MONTHLY for July, 1925, and shown in detail in Blueprint No. 43).

They want to know why they should build this set if practically the same results can be obtained by combining the one-tube receiver with the three-tube amplifier unit.

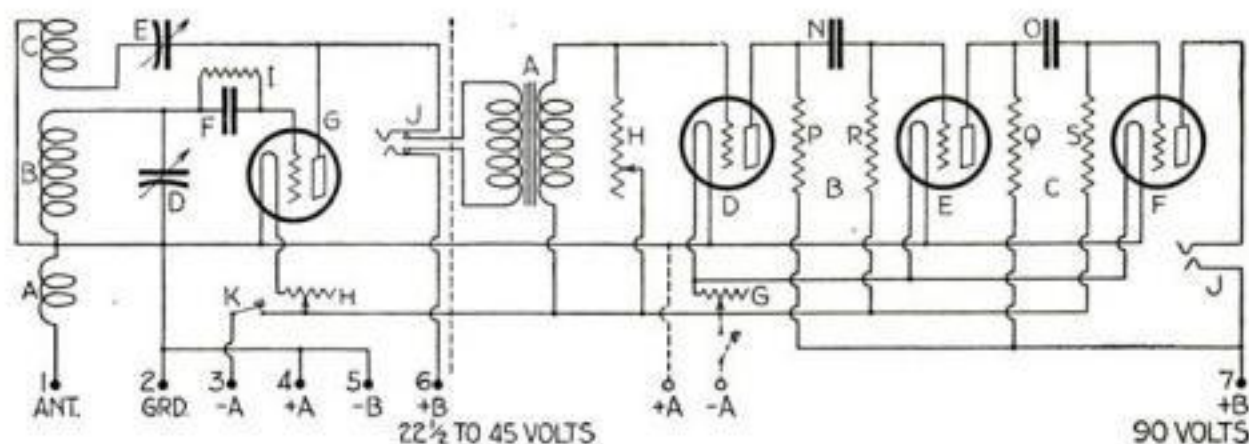
The answer is that the four-tube receiver of Blueprint No. 43 is more sensitive and more selective. This means that, other conditions being equal, the four-tube outfit will bring in stations from a greater distance and do a better job of cutting out local interference. If the radio fan finds that these two qualities are needed to a greater degree in order to give him the kind of radio reception he wants, then the four-tube receiver is distinctly worth while. On the other hand, the four-tube outfit is not quite as easy to build and get going as the simple one-tube receiver plus the amplifier.

THE beginner at radio construction, therefore, should tackle the one-tube set first. Then, if he wants loudspeaker results, he can add the audio amplifier. These two units also can be combined on one 7-by-24-inch panel. In fact, if the radio fan expects, ultimately, to add the amplifier, it is a good idea to make up the one-tube receiver at one end of a 7-by-24-inch panel and purchase the additional parts for the amplifier later. The wiring diagram of these two units that appear with Figs. 4 and 5, shows just how to connect them properly. Note that seven binding posts are shown with the wiring of the outfit in solid black lines. The battery wiring of the amplifier unit, when made up separately, appears in dotted lines. A vertical dotted line shows the separation of the two units.

Many letters have been received from radio fans who own a pair of .0005-mfd. (23-plate) variable condensers, requesting information as to whether these condensers could be used in the one-tube outfit in place of the .00025-mfd. (13-plate) condensers specified.

This change is entirely practical. You must, however, cut down the number of turns in coil B of the one-tube set to about 50 instead of the 68 specified. Depending on the minimum capacity of the larger condensers used, it also may be

(Continued on page 172)



This wiring diagram shows how the one-tube receiver and amplifier unit below are combined

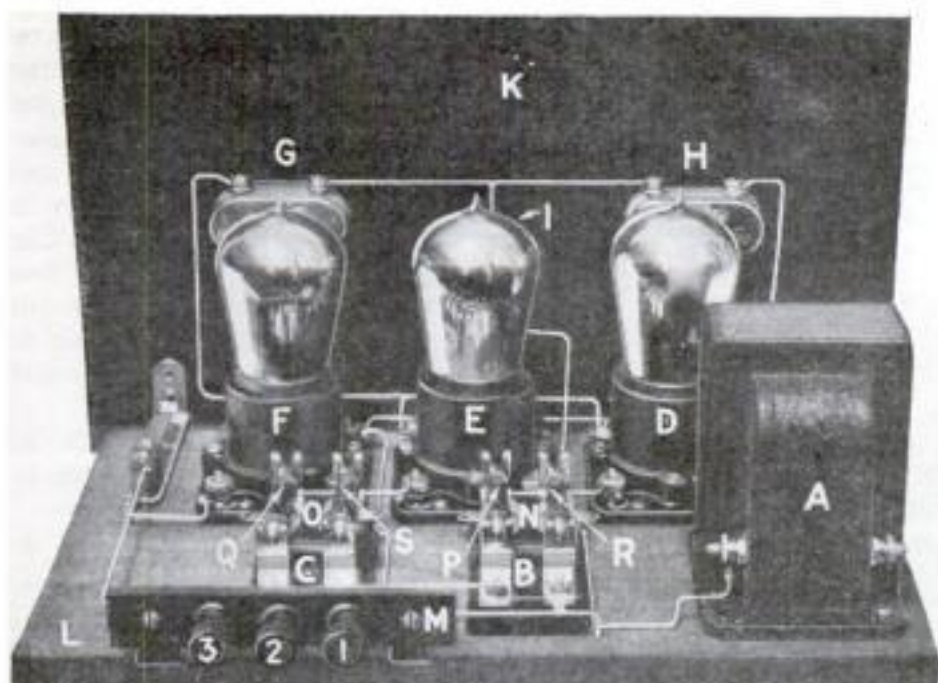


Fig. 4. Layout of parts and wiring for the three-stage amplifier unit described in our June issue, which the beginner can construct easily and add to the one-tube receiver shown in Fig. 5. In the combined wiring diagram above, this unit is shown at the right

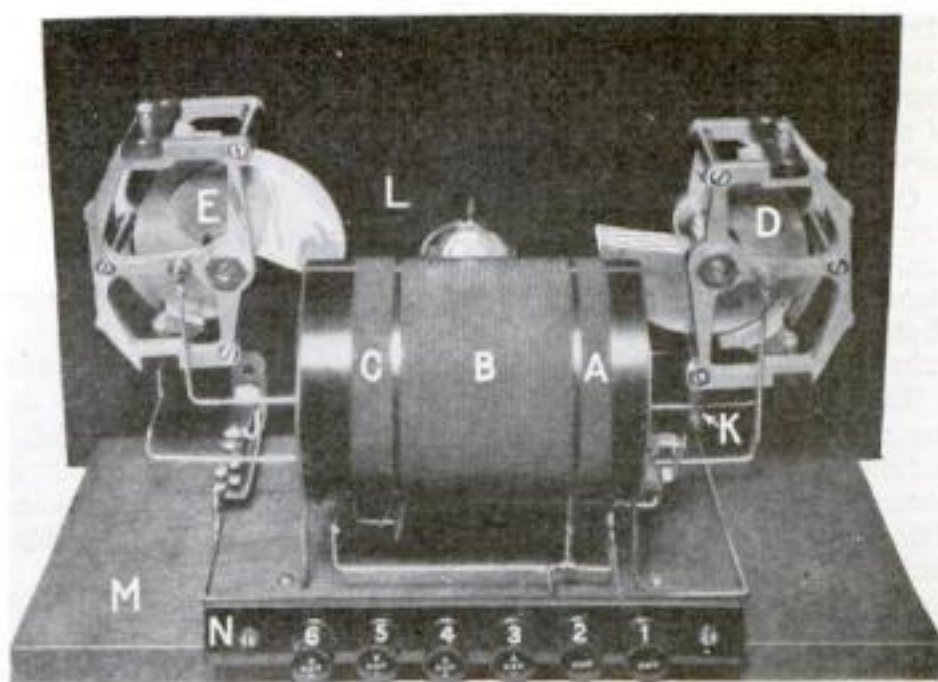


Fig. 5. Arrangement of parts for the one-tube long-distance receiver described in our May issue—a set simple for the beginner to build. In the wiring diagram this unit is shown at the left of the dotted line. Blueprints for both units are available

New Life for Your Radio Tubes

*Remarkable Tests by Popular Science Institute of Standards
Show How Worn-Out Filaments Can Be Rejuvenated*

RADIO vacuum tubes always seem to fail when least expected. A favorite time, apparently, for a tube to burn out or go dead is when you are trying to demonstrate the remarkable qualities of your radio set to some friend. The music starts off with a grand flourish and then suddenly stops completely or fades nearly away.

A vacuum tube that has burned out is beyond recall, of course, but thousands of radio fans do not know that vacuum tubes that have gone dead may be revived. This applies both to tubes that have worn out in service and to tubes that have become paralyzed through the use of too high B-battery voltage or from burning them too brightly in an effort to increase the volume.

Practically all the standard vacuum tubes are what the English call "dull emitters." In other words, the filaments of modern tubes are coated with a substance that gives off a plentiful supply of electrons when heated to a temperature just beyond the dull red point. This material exists on the surface of the filament as an exceedingly thin layer and if the tube is forced beyond the proper limits, the material is exhausted faster than it can be replaced from within the filament itself.

CURIOSLY enough, the way to give your tubes new life is to force them—sort of a "fighting fire with fire" proposition. The forcing process, however, is applied to the filament alone, and the B battery must be disconnected entirely.

In theory, at least, the way to revive radio tubes is to heat the filament to a temperature considerably above the normal. This excess heat appears to have the effect of forcing more of the material to the surface; and since the B battery is disconnected, the material is not used up and accumulates where it can be of use when the tube again is put back in service.

Obviously, no radio tube will last forever. Some tubes will stand the rejuvenation process several times, others only once or twice; but it is safe to estimate that the average life of a modern vacuum tube can be prolonged greatly.

There are three ways in which the coating on the filament can be renewed. To determine the relative effectiveness of these various methods, the Popular Science Institute of Standards Radio Laboratory has just concluded a series of important tests.

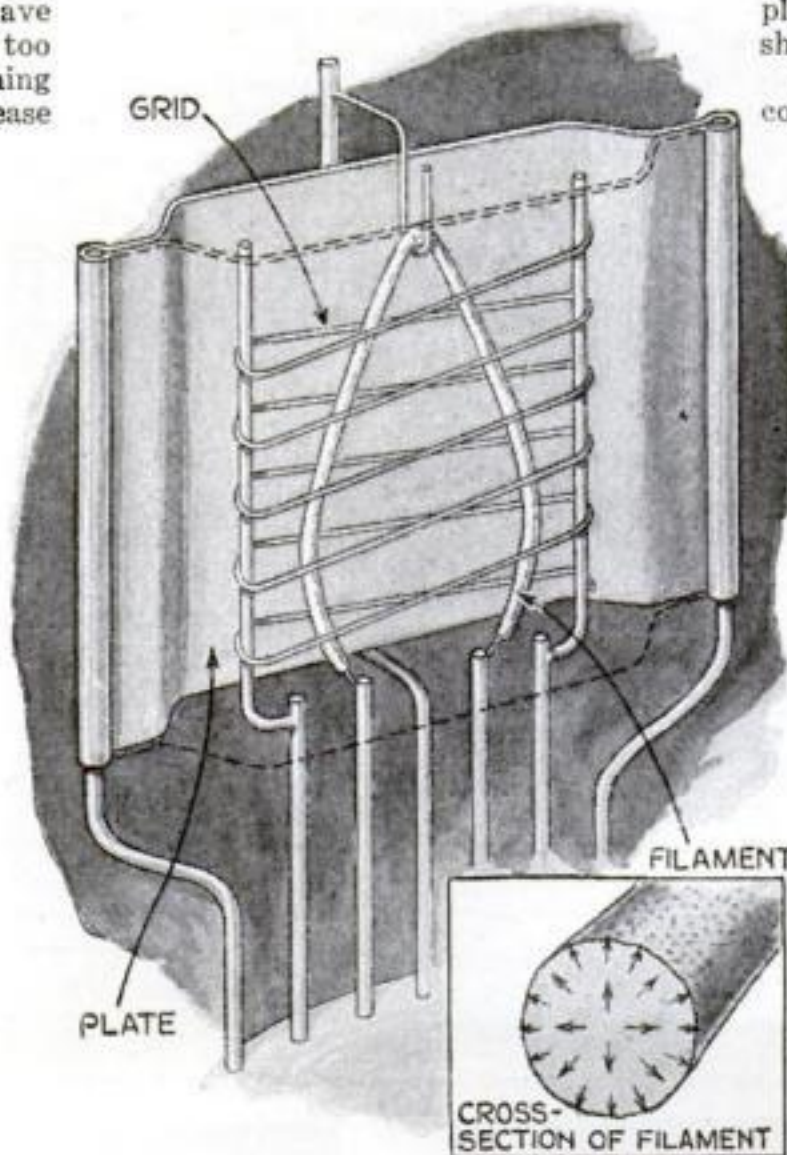
The three possible methods are these:

1. Operate the vacuum-tube filament at normal rated voltage for several hours with the B battery disconnected.
2. The use of a device designed especially for the purpose. It consists, essen-

By Eugene Bruyning

*Member of the Staff of the
Popular Science
Institute of Standards*

tially, of an alternating-current transformer arranged so that a pressure of 17 volts may be applied to the filament of the standard storage-battery tube. The filament is operated at this voltage for 45 seconds, then a switch is thrown that connects the filament with another tap on the transformer, giving eight volts. At this



How Vacuum Tubes Are Rejuvenated

This diagram of the working parts of a radio tube shows how the filament is surrounded by the grid and the plate. When the filament is heated carefully to a temperature higher than normal, the material that gives off electrons is forced to the surface as indicated by the arrows in the inset. The B battery must be disconnected

voltage the tube is allowed to burn for 10 minutes. This device operates from the electric-light socket.

3. The use of batteries to operate the filament for 45 seconds at from 12 to 17 volts, followed by 10 minutes at from six to eight volts.

To start with, in the Institute laboratory tests, we took two new standard storage-battery tubes and paralyzed them so that the plate current on 90 volts with zero grid potential dropped from 7.5 to .1 milliamperes. This was done by applying a very high filament voltage while the

B battery was connected. In other words, we put the tubes in such condition that they were of no further use for radio either as detectors or amplifiers.

One of these two tubes then was treated by the first method. After an hour or two we found that it was restored to the point where the plate current was 5.2 milliamperes, sufficient for radio work, but was not quite as good as new.

THE other tube was treated by the second method, using a standard tube rejuvenator. After treatment the plate current was 8.4 milliamperes—just a shade better than new.

This test, with several others, proved conclusively that paralyzed radio vacuum tubes could be restored to usefulness.

Next we wanted to see what the rejuvenation process could do for tubes that just naturally had given out through long service in a radio receiver.

In the continual testing of receivers, loudspeakers, and other radio apparatus at the Institute laboratory, tubes often are worn out completely in a few weeks or a month.

We took four of these "dead" tubes and treated one by the first method, another by the second. The remaining two tubes were treated by the third method. All the tubes came back to life. They were equally good except the one treated by the first method. This one did not show up quite so well.

THESE tests show that adding life to your radio tubes by the rejuvenation process is a distinctly practical and money-saving process.

A comparison of our results would indicate that the use of a special alternating-current tube rejuvenator is, perhaps, the most practical way for the average radio fan. Equally good results can be obtained by use of direct current from batteries, but most radio fans have no batteries available that will give the requisite voltages. Then, too, there is always the chance of burning out your tubes if you do not happen to hit the right combination: an accident which is not likely to happen with the special devices.

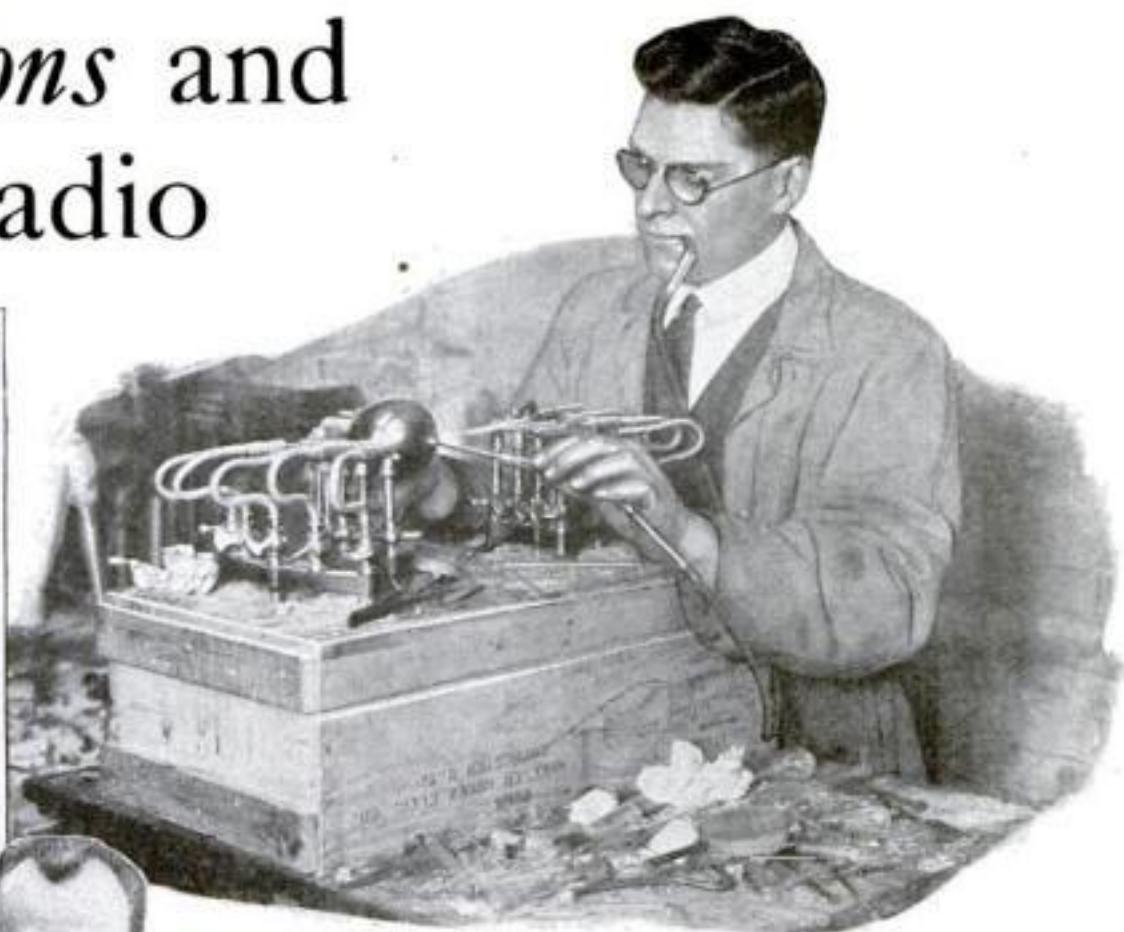
In addition to our experiments with standard storage-battery tubes, we also tried out the effect of rejuvenation on three-volt type dry-cell tubes. The results were substantially the same as for storage-battery tubes. Of course the voltages applied to the filaments of dry-cell tubes were considerably lower than for storage-battery tubes. Nine volts, for instance, is about the right amount for tubes of the three-volt type, with from three to four volts during second period.

Newest *Inventions* and *Oddities* in Radio



Percolator Tops for Insulators

Here are the lead-in insulators used at one of the New York City broadcasting stations. They are made of glass. Two are used for each wire, one inside and one outside, held in place by a long brass bolt that provides a path for the current



College Students Make Vacuum Tubes

The laboratories of Cornell are so complete that the students are able to construct even the vacuum tubes used in their radio work and experiments. The illustration shows Professor B. R. Northrop demonstrating the blowing apparatus



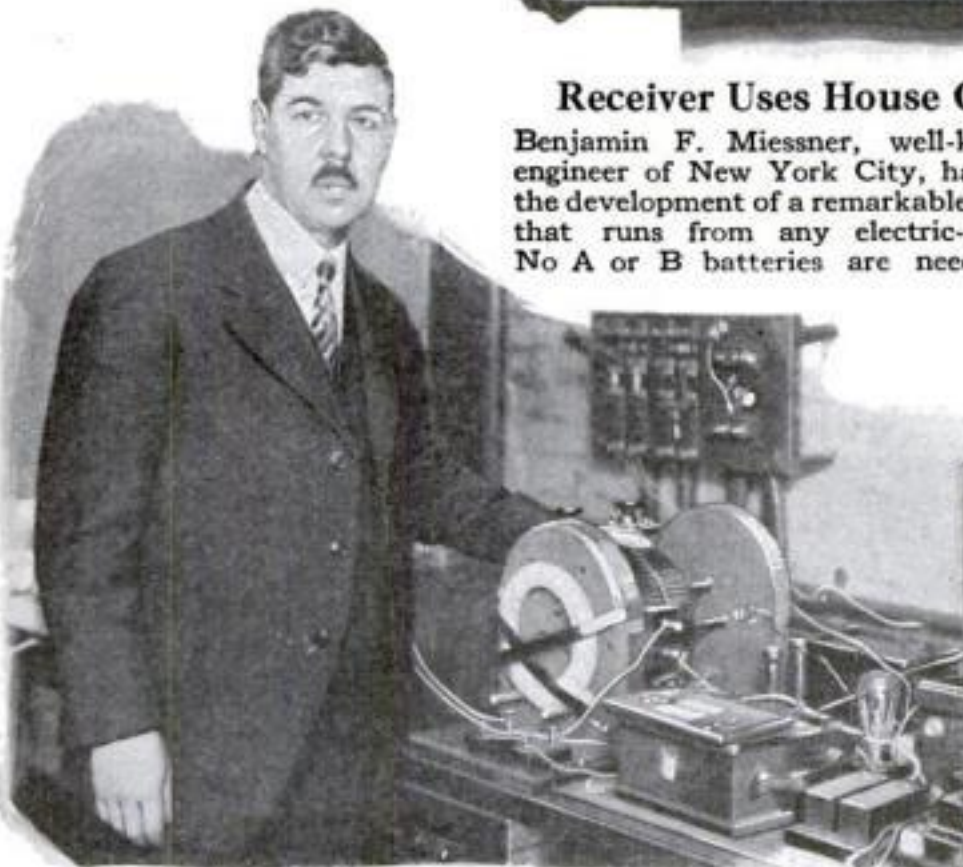
Receiver Uses House Current

Benjamin F. Miessner, well-known radio engineer of New York City, has completed the development of a remarkable new receiver that runs from any electric-light socket. No A or B batteries are needed for this



Unbreakable Tubes

Here is Herbert H. Metcalfe demonstrating a new vacuum tube so tough that even a sharp blow will not break the filament. These tubes can be dropped to the floor without any injury



The Man Who Gave Us the Neutrodyne

Professor L. A. Hazeltine, the man who discovered the principle of the neutrodyne receiver, is the head of the Department of Electrical Engineering at Stevens Institute of Technology. It is said that Professor Hazeltine made his important discovery entirely by mathematical deduction. The principle of the neutrodyne as developed by Professor Hazeltine is to use a small adjustable capacity arranged in the circuit in such a way that it balances the internal capacity of the tube elements and thus prevents the tube from oscillating

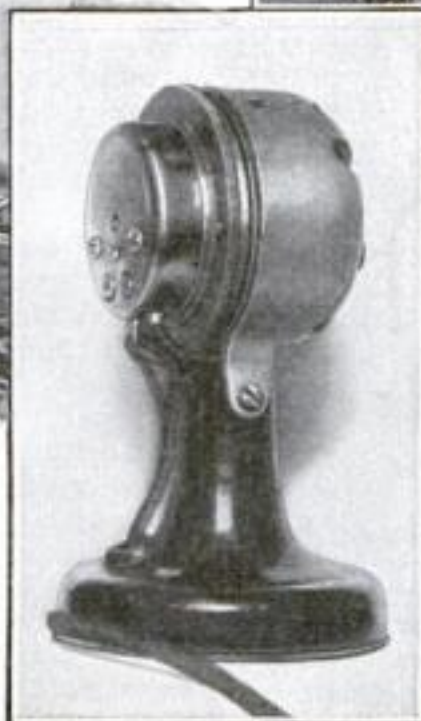


Table Loudspeaker

It is possible, as shown at left, to build a practical and satisfactory radio table-talker out of the frame and pedestal of an old electric fan. The ventilating holes in the frame serve as openings for the incoming sound

Fig. 1. The simplest possible arrangement for hooking up a storage A-battery charger



How to Charge Your Radio Batteries

Simple Methods of Installation that Will Save Time and Trouble

By John Carr

THE trouble and inconvenience of charging radio storage batteries has been greatly exaggerated. Of course, in the days before efficient home chargers were available, the sight of a neighboring radio fan laboriously struggling down the street with 100 pounds or so of battery on his way to a battery service station was enough to deter almost anybody from buying a radio set. But carrying your storage battery to the nearest garage or service station no longer is necessary. Batteries can be charged at home easily, simply, and cheaply. The only prerequisite is that your home be wired for electricity.

Since perhaps 90 per cent of the homes in this country that are wired for electricity are supplied with alternating current, methods for charging storage batteries using this type of current will be discussed in this article.

Storage batteries produce perfectly uniform direct current. Consequently they must be charged by means of a direct current, although the charging current need not be uniform in character. Alternating current, as supplied to your home over the electric-light wires, cannot be used.

Although there is no essential difference in the kind of current needed to charge storage A batteries as compared with that needed for storage B batteries, there is considerable difference in the volume of current and the pressure at which it must be supplied to the two types of batteries. A batteries need large volume at low pressure, while B batteries can be charged only with a small volume of current at much higher pressure.

THERE are on the market at present three distinct types of A-battery chargers. In each a transformer is used to step down the 110-volt lighting current to a lower voltage suitable for A-battery charging. One type uses a special kind of vacuum tube to rectify this lower voltage current before sending it through the storage battery. Another rectifies with an electrolytic cell, and the third uses a vibrating contact arm which is so made that it swings in time with the 60-cycle alternating current. All three types will give good service if properly constructed.

The proper method of connecting the charger with your A battery depends, of course, on the type of charger and the internal connections of the receiver. This is true only when you make a permanent installation controlled by switches arranged so that it is only a matter of throwing a switch to put your battery on charge. With some types of chargers a very simple switch system will give satis-

faction, while the same system, used with another charger, may result in burning out your fuses or blowing out the tubes in the receiver.

In addition to this possibility, the problem of arranging a hook-up for the A-battery charger is complicated further by the fact that several types of battery chargers are made to charge storage B batteries as well as A batteries.

FIGURE 1 shows the simplest possible arrangement. It will work perfectly with the electrolytic type of A-battery charger. It can be used also on the newer bulb-type chargers, which are made so that there is no metallic contact between the primary windings of the step-down transformer and the secondary circuits. Figure 2 shows the proper circuit to be used with older types of bulb chargers and all types of chargers employing a vibrator. Figure 3 is a simple hook-up for the new type of bulb chargers, which are arranged to charge both A and B batteries. This circuit will work regardless of whether the minus B-battery connection in your receiver is made to the plus or minus A circuit.

Chargers made especially to recharge storage B batteries are available in two forms—the vibrator type and the electrolytic cell, as supplied under various

(Continued on page 173)

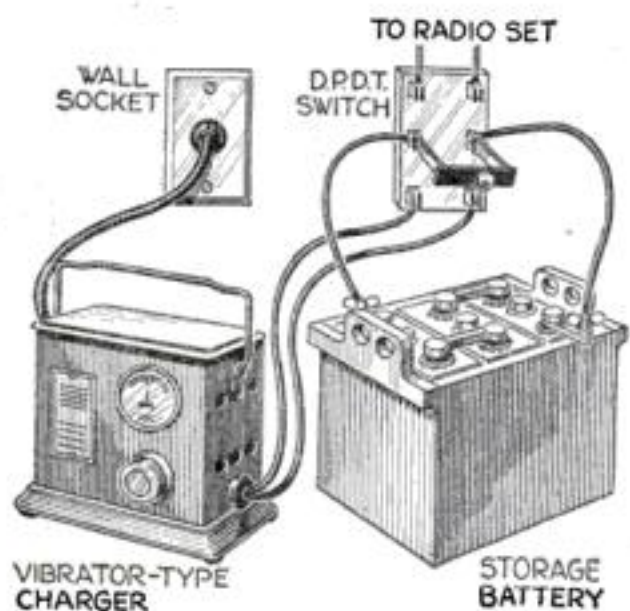


Fig. 2. The correct circuit to use with the older types of bulb chargers and with all types of chargers employing a vibrator

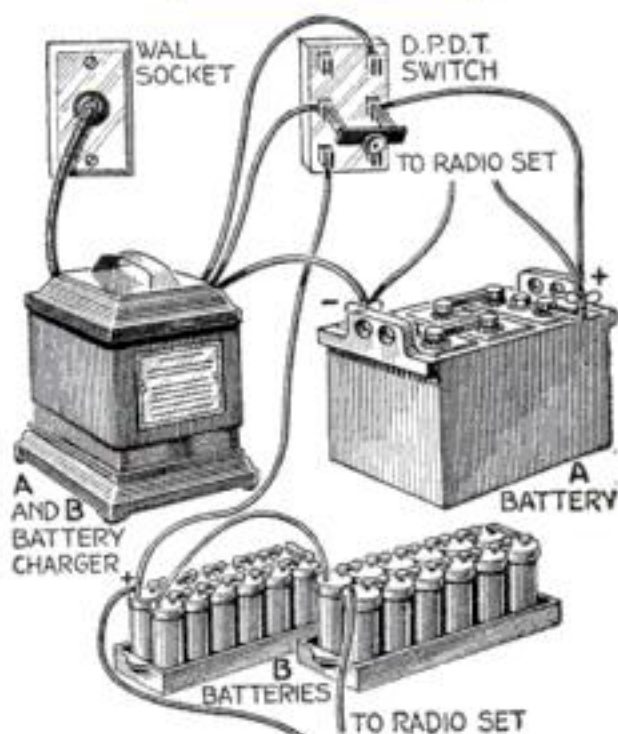


Fig. 3. A simple hook-up for the new type of bulb chargers, which are arranged to charge both A and B batteries

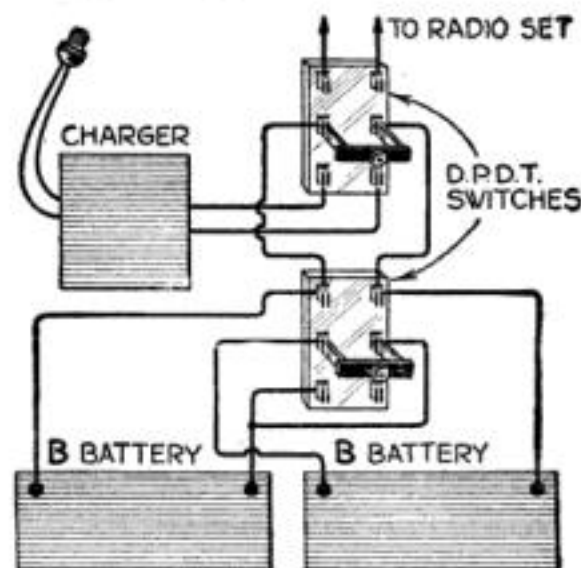


Fig. 4. This arrangement, using two double-pole, double-throw switches, permits disconnecting the B battery from receiver, connecting it with charger, and also arranging the two halves of the battery in parallel for charging

For Well Equipped Cars

Half a Dozen Ingenious New Ideas to Increase the Motorist's Comfort



Rubber Skid Chains Save Tires

Instead of the usual metal links, the cross pieces of this skid chain are made of rubber. Steel side chains hold the rubber cross chains in place. It is claimed the new chain works effectively, except when used on icy streets



Electric Jack Saves Work

Every auto-owner who has had tire trouble on a country road knows that jacking up a heavy car is quite a job. And this is particularly true if the punctured tire is on one of the rear wheels, because of the difficulty of reaching under the car. This ingenious new electric jack makes the auto storage battery do all the work

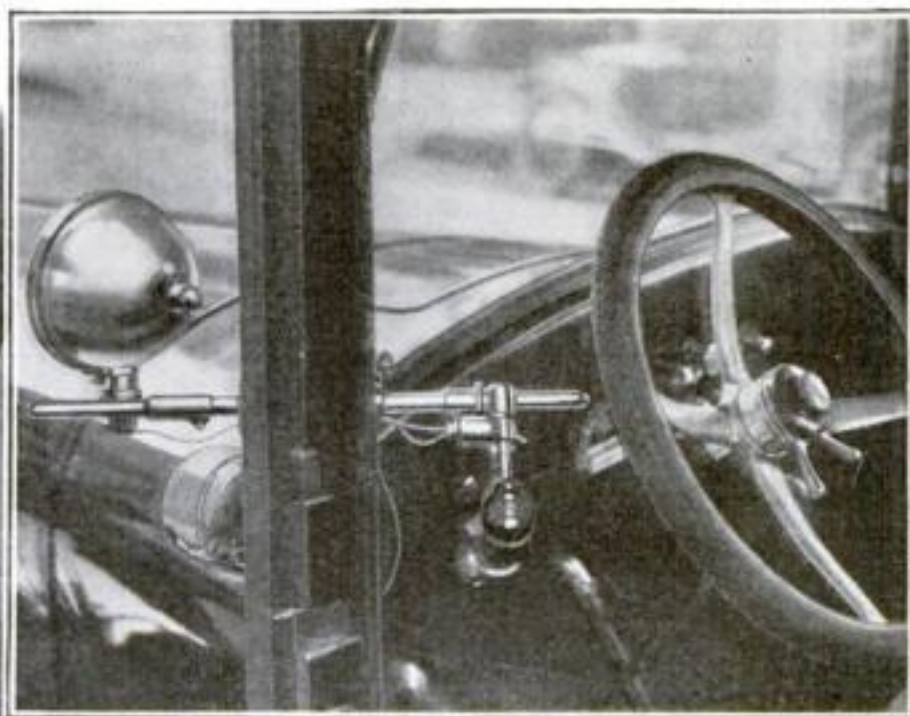


Mudguard Flag Holder

For motorists who like to display flags attached to their cars on national holidays, the device at the left solves the problem simply. It can be clamped to the edge of the mudguard and set to hold the flag in a vertical position. It is padded to protect the car finish

A High-Pressure Grease-Gun

Sometimes a grease or oil channel becomes clogged and the 500 pounds pressure developed by the ordinary grease-gun fails to clear the obstruction. The device shown at the right boosts the pressure up to 5000 pounds, sufficient to force grease through



Spotlight Controlled Inside

As the illustration shows, this remarkable spotlight is mounted on the end of a hollow shaft. At the other end of the shaft, inside the car, there is a knob. Moving the knob up and down shifts the position of the spotlight vertically, while horizontal swing is governed by turning the knob on its shaft. The inner shaft is, of course, used to transmit all motion to the spotlight from the knob near the steering-wheel of the car so that there is absolutely no chance for play to develop

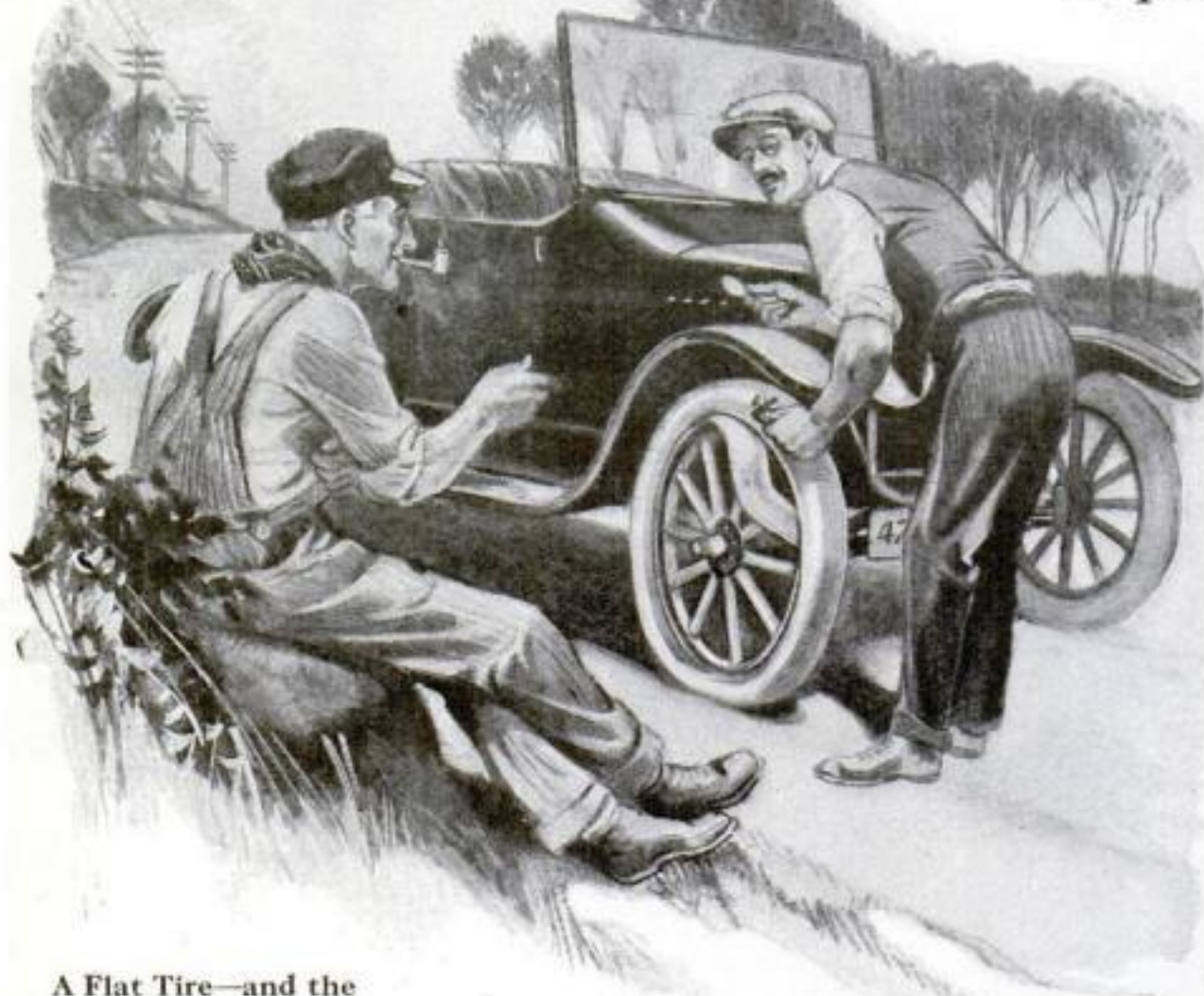


Radiator Cap Includes Clock

This unique radiator cap combines three functions. It tells the time by means of the clock in the center. A thermometer indicates temperature of water in the radiator. At the left another indicator determines the amount of water inside

Gus Reveals Some Tire Secrets

His Easy Ways to Make Roadside Repairs Save a Lot of Time



A Flat Tire—and the Jack Is Missing!

Gus sat on a rock and bossed the job while Joe repaired a punctured clincher tire without jacking up the wheel. The tire was mended quickly and easily with the aid of nothing but tire irons and a "sizzle patch"

By Martin Bunn

"GOOD MORNING, Gus—what do you know about real estate?" said Joe Clark to his partner, just as the latter was unlocking the door of the Model Garage.

"Not a darn thing at this time of day," Gus growled crossly and a bit sleepily.

"Oh! All right, you old grouch!" grinned Joe. "I only wanted to tell you that there's a house up my way that I want to buy. I thought maybe you'd take a run up there with me and tell me if it's a bargain."

"Humph!" grunted Gus. "One of those places over on Biddle Avenue, I suppose?"

"No, sir!" answered Joe emphatically. "This one is on East Main Street."

"I don't know anything about those houses," said Gus, showing a bit more interest. "Suppose we take a run up there this afternoon and give it the once over. The kid can take care of the gasoline pump, and business is slack now anyway."

Along about half-past three Joe suggested that it was time to start, and the two men climbed into Joe's flivver and started off, leaving Bill, the kid who did odd jobs around the garage, standing importantly beside the gasoline pump. This was the first time he had been left in charge of the place, and he was as proud as a peacock.

"Gosh!" exclaimed Joe, as they rattled down the road. "This boat certainly does steer hard. I can barely keep it on the road."

Gus looked at his partner with a pained expression on his face.

"Son," he said, "as a bookkeeper you are a whiz, but you are surely a dummy about autos. Haven't you seen that this bus rides as rough as a broncho? I was just waiting for you to notice that your right front tire is almost flat! I suppose it would have to come right off the wheel before you'd get wise."

Joe appeared decidedly crestfallen as he stopped the car at the side of the road. And his face registered downright chagrin when he discovered that the jack was missing from the toolkit.

"Whatever became of that jack, I wonder?" he muttered disgustedly. "Now I suppose we will have to run back to the garage on the flat tire and ruin it in the process."

GUS meanwhile had been poking around in the toolkit.

"Drive back nothing!" he said emphatically. "What do you suppose these 'sizzle patches' are for, except to repair flat tires with?"

"Sure, I know what they are for," said Joe; "but what good are they to us if we have no jack to take off the tire?"

"Don't worry about that," replied Gus; "just you get behind this bus and push it along slow so I can see if I can locate the hole."

Gus kept a sharp watch on the slowly revolving front tire and his keen eyes soon spotted the head of what turned out to be

an extra long carpet tack in the rubber.

"Now," he said, "this is your car and I am going to light my pipe and boss the job while you do all the work. Get out your tire irons, the clamp, and sizzle patches."

JOE did as directed, for he long since had learned that when Gus said he knew how a thing could be done, he was pretty sure to be right.

While he was locating the irons, Gus filled his pipe and settled himself comfortably on a near-by rock.

"Get busy with the irons now and pry off the bead of the tire right where we pulled out the tack and for eight or 10 inches on each side of the puncture. That's the idea," he nodded, after a few minutes of strenuous work on Joe's part. "Now pull out the tube and find the hole."

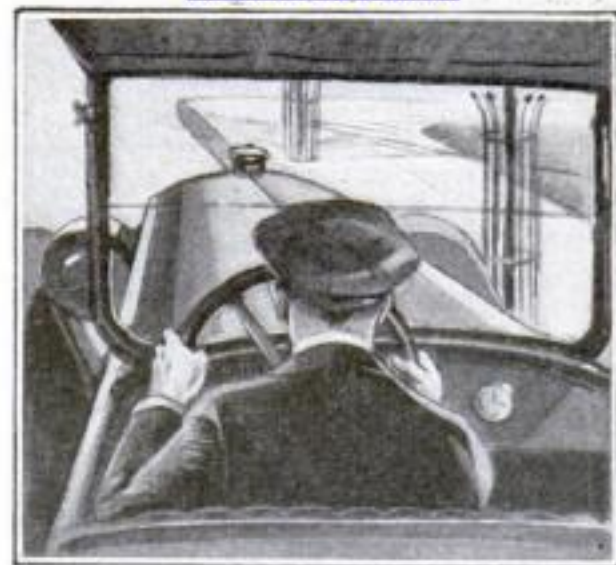
Joe meekly followed directions and when he had found the puncture in the tube, he proceeded to scrub the surface of the rubber surrounding it with a rag dipped in gasoline from the tank, tore off the protecting paper from the uncured rubber on the bottom of the tin sizzle patch, clamped it firmly in place over the hole, and finally touched a match to a corner of the brown cardboard-like substance, which immediately started to sizzle and fume like a firecracker fuse.

GUS settled back to enjoy his pipe while the patch was cooling.

"In five minutes, or thereabouts, we should be on our way," he said. "And you will kindly notice, Joe, that we did not need the jack after all. Of course, you couldn't do that with a straight side tire, but it's a handy kink to know if you own a light car fitted with clincher tires."

After waiting the prescribed time, Joe pushed the tube back into the shoe, pried the bead on the rim, pumped up the tire,

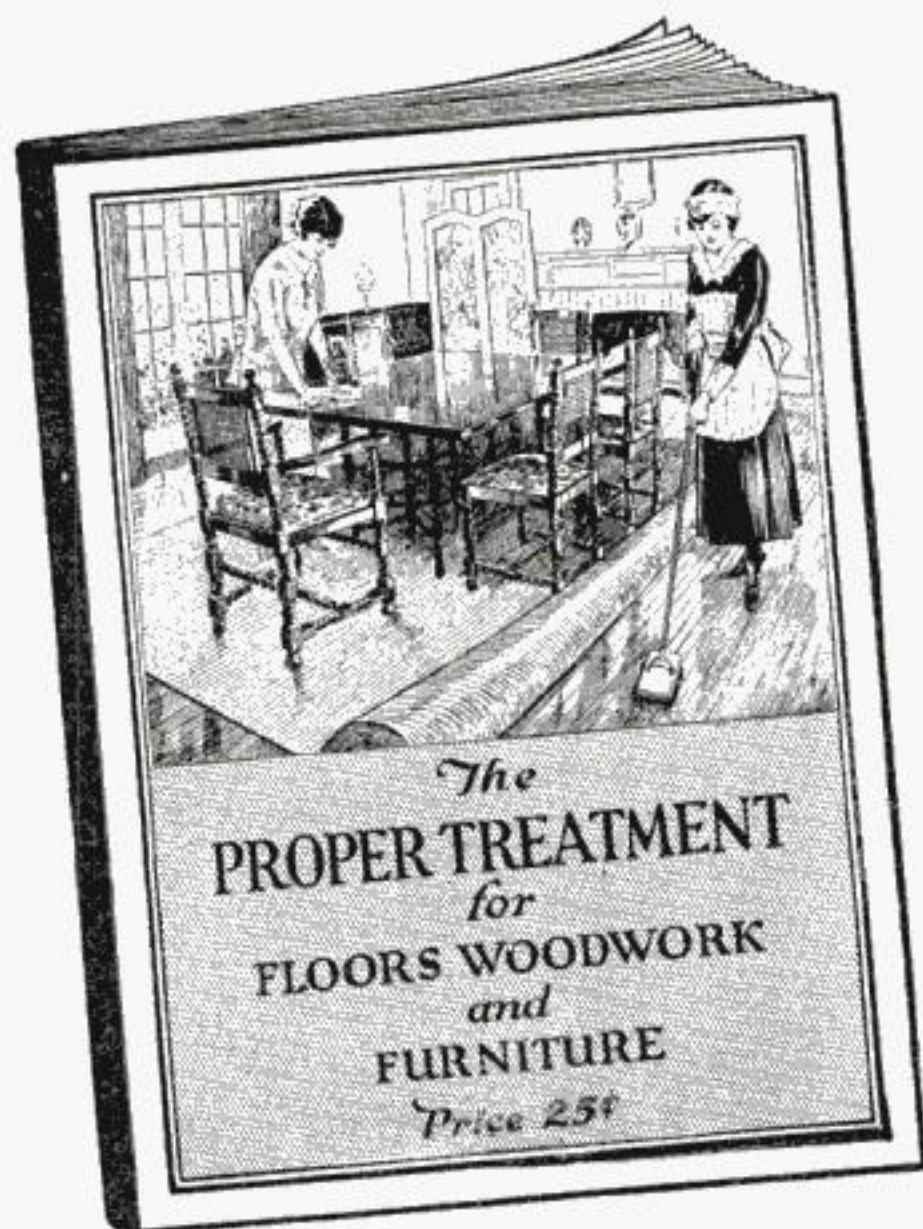
(Continued on page 66)



A Sure Guide for Parking

To avoid scraping tires against the curb in parking, Joe invented an ingenious scheme for gaging distance. With his car parked correctly, he got in the driver's seat and observed just where the curb line appeared in relation to the top of the radiator. After that it was a simple matter to judge the distance from the curb by repeating the same line-up when he drew up to the edge

FREE—Valuable Instruction Book on Wood Finishing



It tells how inexpensive soft woods such as pine, cypress, birch, fir, etc., may be finished so they are as beautiful and artistic as expensive hard woods.

Tells how you can easily and economically put furniture, floors and woodwork in perfect condition. How to finish wood in beautiful stained effects with Johnson's Wood Dye and in up-to-date enamel effects with Johnson's Enamel.

How to Get it—FREE

Ask your best paint or hardware dealer for a FREE copy of the Johnson 25c Book on Wood Finishing. If your dealer cannot furnish this Book—mail the coupon to us, giving the name of your dealer, and we will gladly send you a copy free and postpaid.

This book is the work of experts—profusely illustrated in color.

JOHNSON'S WOOD DYE

Penetrating

Dark Oak
Fumed Oak
Dark Mahogany
Light Mahogany

Light Oak
Golden Oak
Mission Oak
Weathered Oak

Walnut
Bog Oak
Flemish Oak
Early English

Johnson's Wood Dye is very simple to apply—it goes on easily and quickly without a lap or a streak. Dries in four hours and will not rub off or smudge—penetrates deeply, bringing out the beauty of the grain without raising it in the slightest. All shades of Johnson's Wood Dye may be easily lightened or darkened.

Johnson's Wood Dye is a *dye* in every sense of the word. It penetrates so deeply that the natural color of the wood is not disclosed. Like most first class products Johnson's Wood Dye answers one purpose only—it *dyes* the wood; a finish must be applied over it—we recommend Johnson's Varnishes or Johnson's Polishing Wax.

The Symbol of the Specialist



The sign at the left distinguishes the Wood Finishing Specialist from the ordinary paint store. All stores displaying this sign carry a full line of Johnson's Artistic Interior Wood Finishes. They will gladly give you a FREE copy of the Johnson 25c Book on Wood Finishing and are competent to answer questions and give advice on the proper finishing of wood. Ask them to show you wood panels finished the "Johnson way".

S. C. JOHNSON & SON, Dept. P. S.10,
"The Wood Finishing Authorities"
RACINE, WIS.

Please send me free and postpaid a copy of the Johnson 25c Instruction Book on Wood Finishing and Home Beautifying, "The Proper Treatment for Floors, Woodwork and Furniture."

Name.....

Address.....

City and State.....

Dealer's Name.....

(Continued from page 64)

and they proceeded on their journey.

Soon there came the sound of a motor horn. Gus looked around to see who it was trying to pass.

"It's old Mr. Conklin," he said. "Give him plenty of room. The old duffer can't see well, and he's liable to tear off a mudguard for you."

Joe pulled over close to the edge of the road and Conklin rolled by.

"Look!" exclaimed Joe. "He has a flat tire too!"

"Give her the juice!" Gus called out sharply. "That's a new tire he bought from us. We can't let him ruin it."

JOE opened the throttle and the little car quickly picked up speed. The chase scarcely had begun, though, when there came a resounding report from the car ahead.

"Now I suppose he'll blame us for selling him a defective tire," Gus grunted. "Well, pull in behind him. We might as well take our medicine."

But this time, both Gus and Joe were wrong. The soft tire had not blown out. It was, instead, an old tire on the right front wheel of Conklin's car that finally had let go.

Conklin was climbing out as the little car pulled in behind him.

"Hello," he hailed them. "You arrived just in time. You can help me change tires."

"That's why we were trailing you," said Gus.

"How did you know I was going to have a blow-out?" asked the other in surprise.

"I didn't, but your left rear tire is almost flat. We were trying to overtake and warn you when the other one surprised us by blowing out."

Conklin swung around with a grunt.

"More bad luck," he said gloomily. "Two flat tires and only one spare. What am I going to do about it?"

"Nothing to it," said Gus. "Put the spare on in place of the blown-out front shoe, and we'll fix this soft one for you. Got a jack in your toolkit?"

CONKLIN produced a jack and a couple of spindly little tire irons about eight inches long.

Gus looked disgustedly at the tire irons. "There's a real tire iron," he said, holding up a two-foot length of spring leaf. "You can't do good work on tires without at least one real man-sized iron."

"Look here, Mr. Conklin," Gus continued, as he examined the front tire, "this tire is junk. You have got pretty good mileage out of it, judging from the looks of the tread; but you certainly knocked off at least a thousand miles by scraping against the curbstone so much. See,

—the blowout came right where the side wall of the tire was worn nearly through."

"By jinks, you're right," exclaimed Conklin, bending down and peering over the rims of his glasses at the ugly hole in the side of the casing. "You know, I never can tell when the wheels are close to the curb, and what with all these new-fangled regulations about parking close to the curb, the only way I can be sure is to edge in till I feel the tire scrape."

"Yes," Gus replied, "lots of people have the same trouble. Even Joe, here, wore out a couple of front shoes before he invented a scheme that works fine. Tell him about it, Joe."

"Well, as Gus says, Mr. Conklin," explained Joe, "I couldn't seem to gage the distance from the curb to the tires at all, but finally I hit on a scheme that works out fine. First, you park your car carefully, getting out and observing its distance from the curb and moving closer or farther away until it's just right. Then you get into the driver's seat, look over the front of the radiator to the point where the street touches the curb and notice just where this line appears in relation to the top of the radiator. After that, all you have to do to park the car at any time is to be sure that you are in the same driving position and watch the curb line and the radiator until they line up right."

"Sounds like a good scheme," said Conklin. "I'll try it out."

BY THIS time, Gus had the blown-out tire off the wheel, and had substituted the spare. Joe tightened up the rim bolts and then jacked up the rear wheel.

"Must be a slow leak," Gus growled disgustedly, as he carefully looked over the tread of the soft rear tire without finding any visible cut or nail in its corrugated surface.

With a hammer, he pounded the lock on the rim around to the open position and then, raising the tire high in the air, he brought it down on the ground with a thump. He made sure, of course, that the point of impact was about six inches from the break in the rim and on the side opposite the locking lever. The jar snapped the rim open and it was then a



One Way to Find a Slow Leak

"I didn't see it," said Gus. "I could find it just as well in the dark. The eye is a sensitive organ, and mine felt the small stream of air that was coming out of the tiny hole"

simple matter for Joe to pry the tire off the rim with the erstwhile but treasured spring leaf.

"How are you going to find the leak?" Conklin questioned, as Gus pulled the tube out of the casing. "We haven't any water to put it in and watch for the bubbles."

"That's easy," said Gus smiling; "just watch."

HE PUMPED up the tube to a diameter considerably larger than normal, and then passed the tube, inch by inch, close to his eyes.

"There!" he called out suddenly. "The hole is right here."

"I wish I had eyes like that," said Conklin admiringly, "I never could see a hole as small as that. I even can't see it now you have pointed it out to me."

"I didn't see it either," said Gus. "I could have found it just as well in the dark. The eye is a pretty sensitive organ, and mine felt the small stream of air that was coming out of the hole. Blowing up the tube till it was good and fat stretched the hole so that a lot more air came out than when it was in the tire."

Gus pulled a stubby indelible pencil out of his pocket and carefully ringed the hole on the tube so that he would not lose track of its location. Then the clamp and sizzle patches were brought out again and shortly thereafter Conklin's car was resting on four inflated tires.

"I'M EVER so much obliged," said Conklin gratefully, as he climbed in behind the wheel. "Have another new tire ready for me tomorrow. I'll stop in some time in the morning."

"By the way," he went on, "I've been thinking of fitting the old bus with balloon tires. What do you think of the idea?"

"I don't think much of it," answered Gus candidly. "The tires you have are over-size, and your car isn't heavy, so you can run the tires at fairly low pressure without injuring them. A whole set of balloon tires with new wheels for them would cost you quite a bit of cash. And, besides, the slight improvement in the riding quality would not be worth

(Continued on page 174)



A Spring-Leaf Tire Iron

Using an old spring leaf as a tire iron, it was a simple matter for Joe to remove the tire of Mr. Conklin's car from its rim. The extra leverage was also a decided advantage

Let Gus and Joe Help You!

THE Model Garage is a *real* place, and Gus Wilson and Joe Clark are *real* men, although, of course, fictitious names have been used to disguise the identity of the two veteran automobile men in Mr. Bunn's fascinating series of stories.

Mr. Bunn assures us that Gus and Joe will be glad to answer any questions addressed to them in care of the Automobile Editor.



For the man who enjoys good tools

"The Saw Most Carpenters Use"

Here are the things that prove a saw:



Balance, hang, easy running—
Fast, clean, true cutting—
An edge that holds its keenness—
Enduring usefulness

®



Disston D-8. The world's standard for all-around work.



Disston D-115, the saw for those who want the utmost in finish and service.



Disston D-23. With narrow blade $1\frac{3}{4}$ " wide at point, $6\frac{1}{4}$ " at butt.

ASK DISSTON about the saws
you need for your work.

THESE are the standards by which Henry Disston judged a saw. The standards to which he himself made the saws that bore his name.

First he improved saw workmanship, making better saws with his own hands. Then he trained other men to make them as he did.

Then he developed America's first crucible saw steel—Disston Steel—a steel so strong, tough, springy and hard that no other steel is like it.

Eighty-odd years have

gone into the improvement of Henry Disston's methods. Sixty-odd into refining his steel.

Today the Disston Saw is the saw for the lover of good tools. For the carpenter, the mechanic, the farmer, the householder—

For balance; for fast, clean cutting; for lasting keenness; for a lifetime of service.

Get your Disston at the nearest hardware store. Test it for these things in your own hands.

Henry Disston & Sons, Inc.
Philadelphia, U. S. A.

Hardware dealers the world around sell Disston Saws, Tools, and Files

DISSTON

® This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Eight Useful Hints for Autoists

Timely Precautions Result in a Smooth-Running Car

AFTER several years of service, many automobiles give trouble through overheating. Generally the cause is a clogged radiator and water jacket, although frequently worn rubber hose used to connect the parts of the water circulating system may be to blame. The best way to clean the inside of the radiator and the cylinder water jackets is to flush out the whole system with about five gallons of water in which about a half pound of lye has been dissolved. Fill the radiator with this compound and run the engine until it is hot, then drain the solution off and flush out the radiator several times with fresh water. While you are about it, you may as well clean the cooling fins by squirting water through them with the hose as shown in Fig. 1.

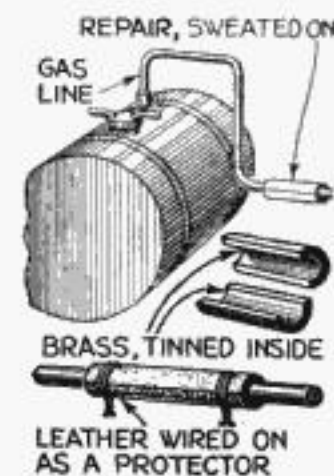
Do not direct the water against the radiator from the outside, as it will be sure to get on the car's ignition system.

WHEREVER the roads are soft, automobilists are occasionally in difficulty because the car wheels sink so deeply in the mud. It is usually the custom in such localities to carry a block and tackle.

Figure 2 shows a simpler device. It consists of a wooden trough made of heavy planking. A row of large nails prevents the board from slipping in the soft mud. Wooden cleats should be nailed over the heads of the spikes. They will give traction to the tire and also prevent a puncture.

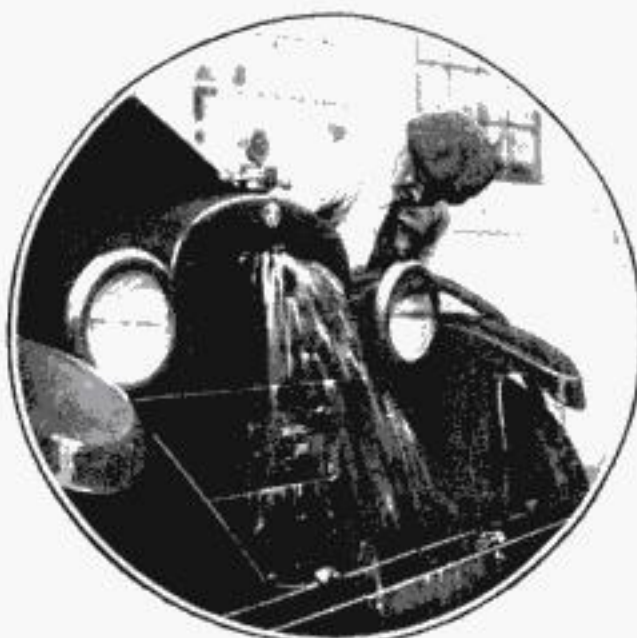
SOME automobiles are not fitted with a petcock between the vacuum tank and the main tank, so the only way to get gasoline out is to disconnect the gasoline pipes. This has its disadvantages, for the connection often leaks when it has been replaced.

If a piece of rubber tubing is available, the gasoline may be siphoned out. The pipe is pushed in slowly through the filler-cap opening until just a couple of inches remain outside of the tank. Then the outer end of the pipe is folded over against itself and held tightly (as shown in Fig. 3) while the other end is pulled out



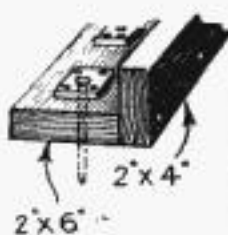
Fixing Gas Pipe

Fig. 5. A metal or leather sleeve over gas pipe prevents breaks



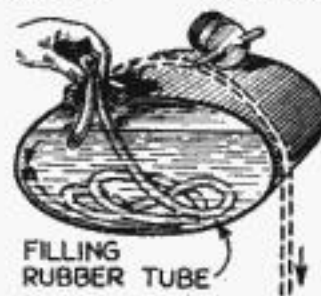
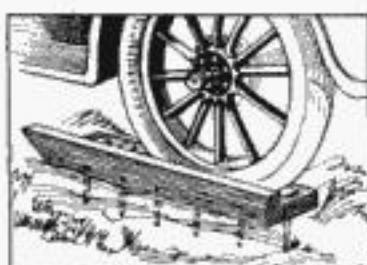
How to Clean the Radiator

Fig. 1. In time, engines become overheated because of a clogged radiator and water jacket. This picture shows how to flush out the cooling fins with fresh water from a hose, the stream being directed outward



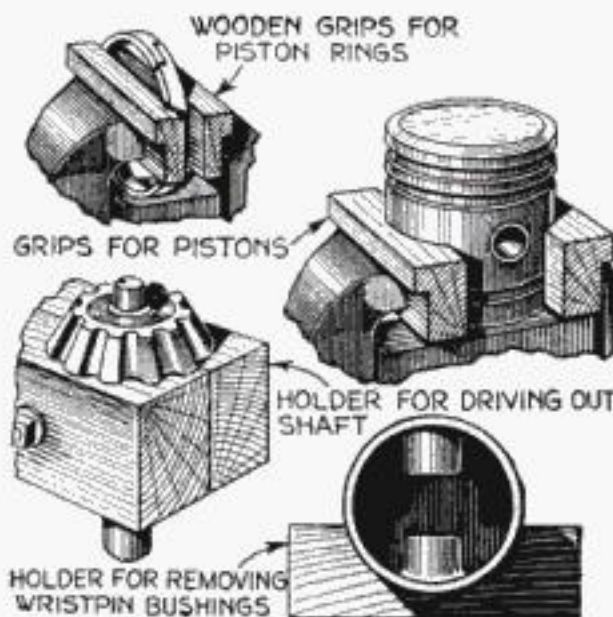
To Pull Car from Mud

Fig. 2. Wooden trough is a great help when a car is stuck in the mud



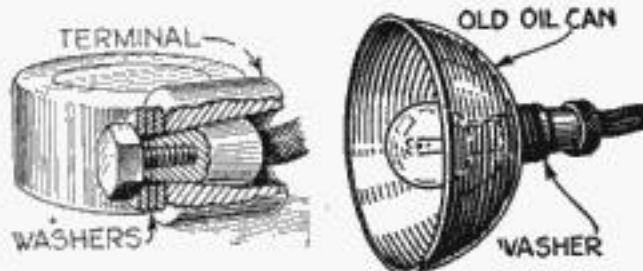
A Gas Siphon

Fig. 3. Rubber tubing bent as shown will siphon gas



Wooden Blocks Protect Metal

Fig. 4. Vise marks on a car indicate carelessness. With a set of wooden blocks, pistons, rings, and gears may be supported, surfaces protected, and breakage reduced



Tightening Battery Terminals and a Trouble Light

Fig. 6. An ordinary iron washer will tighten up a worn tapered lead plug on cable end connecting with battery terminal. Fig. 7. A discarded oilcan makes a satisfactory trouble-light holder with nozzle removed, a standard socket soldered in, and a bulb added

support various parts. Besides protecting the surface of the part, the wood supports the metal and eliminates chance of breakage.

THE gasoline pipe that leads from the main tank to the carburetor or vacuum tank should be inspected occasionally to make sure that it has not loosened. When this happens, the vibration of the automobile results in continually rubbing the pipe against some part of the car so that the pipe wears thin and a leak develops.

For dependable and easy repair, drain the tank or shut off the valve at the tank end of the pipe line and disconnect the pipe. Scrape the surface of the pipe at the thin point where it has chafed through and tin all around the hole with a hot soldering iron. Next, cut a sleeve of thin sheet brass and bend to fit the pipe. Now tin the inside surface of the sleeve, place it over the break, and sweat it in place until the solder has run in between sleeve and pipe.

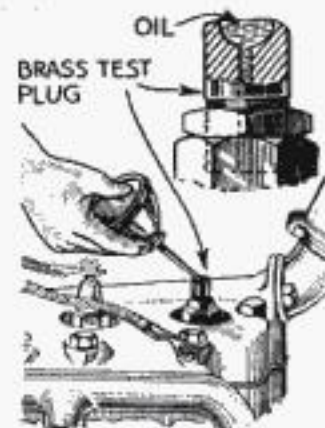
If any part of the car is found rubbing against the pipe, a leak may be avoided by fitting the pipe with a leather sleeve wired on, as shown in Fig. 5.

THE tapered lead plugs on the end of the cables that connect with the storage-battery terminals sometimes become worn. When this happens, use ordinary iron washers around the nut so that the tapered plug will be pulled tightly into the tapered hole in the battery terminal (as in Fig. 6).

AN OLD oilcan will make a good trouble-light holder. The nozzle is discarded and the bottom cut out, so that the edges of the hole are round and smooth. A standard socket is soldered in place, as shown in Fig. 7, with a washer for greater security.

IN TIMING the ignition system, it is necessary to determine the piston's top dead center.

A simple and accurate way is to make a test plug of an old spark plug and a piece of brass, as shown in Fig. 8. The brass piece is threaded and after a cup-shaped depression has been cut a small hole is drilled through the piece, using a No. 50 drill. Place a little cylinder oil in the cup and turn the crank slowly. The air in the cylinder will bubble up and stop at the top dead center.



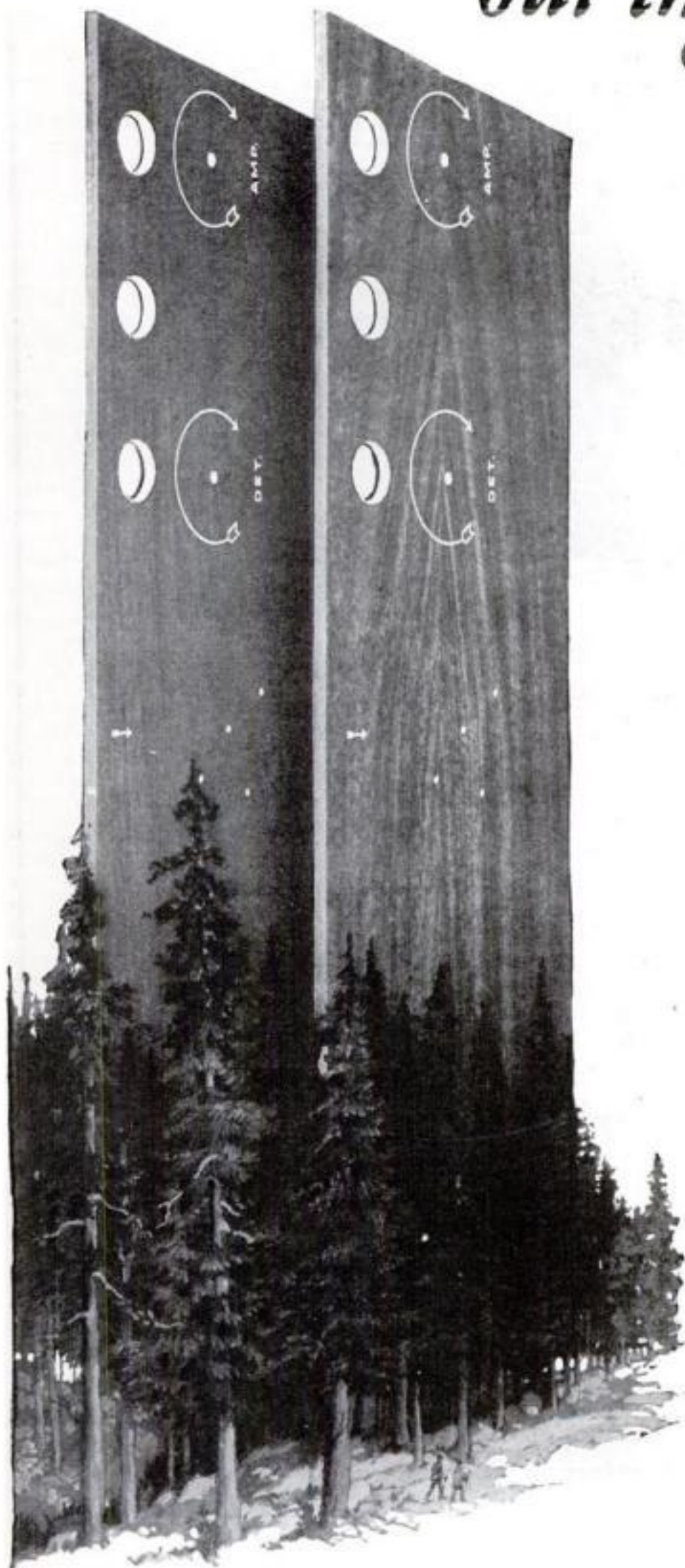
Piston's Dead Center

Fig. 8. Spark plug and wire device show piston's top dead center

VISE marks on your work stamp you as a poor mechanic. Always use wooden blocks when you clamp any important part.

Figure 4 shows how to make wooden blocks

It's mahogany to the eye- but in fact it's Bakelite



So perfectly is the grain and color of mahogany and walnut reproduced in these Bakelite Radio Panels, that the eye cannot distinguish them from the natural woods.

By using a Bakelite Panel that matches the wood in the cabinet, your finished set will be far more handsome than if a plain panel is used.

Rigid and strong, Bakelite Panels support the weight of heavy instruments without sagging. They will not compress, nor cold-flow, under pressure of binding screws. Because of their resistance to extremes of heat, cold and moisture, they will not warp or split. These properties and their insulation value, color and finish are permanent.

Be sure to ask your dealer to show you these wood finish Bakelite Panels—obtainable under any of the following trade-names:

FORMICA

CELORON

Dilecto

Spaulding

Fibroc

Micarta

A Bakelite Panel on a set is an indication that the manufacturer has used the best.

Write for Booklet 25

BAKELITE CORPORATION

247 Park Avenue, New York, N. Y.

Chicago Office: 636 West 22nd Street

®

Bakelite is an exclusive trade mark and can be used only on products made from materials manufactured by the Bakelite Corporation. It is the only material which may bear this famous mark of excellence.

BAKELITE

REG. U.S. PAT. OFF.



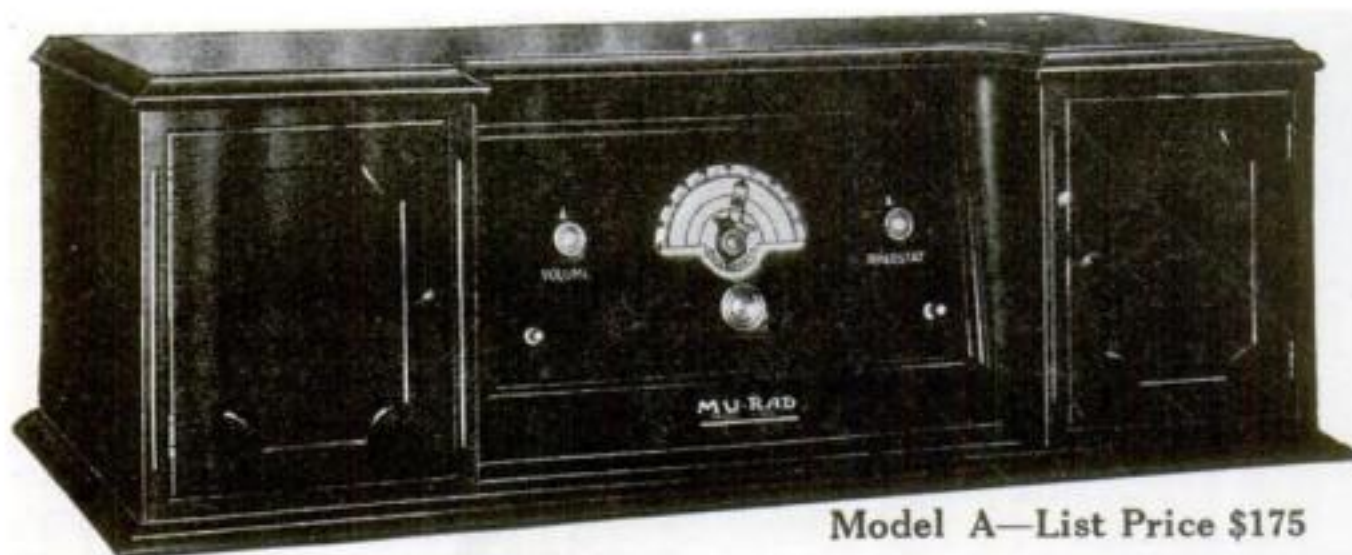
BAKELITE
is the registered trade mark for the phenol resin product manufactured under patents owned by the Bakelite Corporation.

THE MATERIAL OF A THOUSAND USES

® This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Copyrighted material

Radio's Outstanding Achievement



Model A—List Price \$175

THOSE persons who have delayed buying a Radio Receiver in the belief that "something newer and better" would appear, as well as those who have Radios but are not satisfied with results hitherto obtainable, will find the New Mu-Rad a revelation in the art of radio reception.

This remarkable receiver is the culmination of 8 years of study and laboratory experimentation of the Mu-Rad engineers, plus the knowledge gained by the mistakes and the progress of the entire radio industry.

The Mu-Rad Transcontinental Receiver

is a distinct advance in radio—a year or two ahead of the times. Its ideal circuit embodies two stages of **tuned** Radio Frequency, a Detector and two stages of Audio Frequency.

Great progress has been made by Mu-Rad engineers in eliminating lost energy in the circuit and in balancing the circuit so as to secure a degree of selectivity hitherto unknown in a Radio Receiver.

Coast-to-Coast reception **all year around** is made possible with this receiver and the quality of reception is extraordinary.

Ask Your Nearest Dealer for Demonstration

ONE DIAL CONTROL

A revolutionary feature of the New Mu-Rad is its one dial control. There is only one dial to tune. A slight movement of this beautiful Gold Finish dial brings in one station after another—clear across the continent—without interference from local stations. The dial can be accurately "logged." Stations will always come in at the same dial setting. It's as simple as turning a doorknob.

**A Child Can
Operate It**

®

MU-RAD RADIO CORPORATION

Factory
Asbury Park, N. J.

Sales Office
Newark, N. J.



The Home Workshop

Arthur Wakeling, Editor

A New Way to Cover Cracked Plaster

How Ceilings and Walls Can Be Repaired with Wallboard at a Relatively Low Cost

By Edwin M. Love

SO COSTLY and inconvenient are small plastering jobs that the homeowner hesitates to go to the expense of renewing cracked or loosened plaster in his house. By means of wallboard,

however, the handy man can make an unsightly room very attractive. And this can be done at little cost and with a minimum of disorder and dirt.

There are several varieties of wallboard on the market, but those of fiber construction, because of their flexibility and



Fig. 1. The 1 by 4 in. furring strip is shown at A, the upper cornice member $\frac{1}{2}$ by $3\frac{1}{4}$ in., at B, the side cornice member at C, the picture molding at D, and the wallboard at E

lightness, are probably the best for the home mechanic. They usually are made in 4-ft. widths.

If the plaster is attached to the lath with fair solidity, as is generally the case, apply the wallboard over it, otherwise remove it to the lath.

Much wallboard, especially that of the heavy, plaster type, is applied in such a way that the joints can be filled with a plaster composition and the wall then papered. This is, perhaps, the most inexpensive method, but the seams are apt to show through the wallboard in time.

A BETTER method than attempting to paper over the seams is to cover the joints with "batts" or decorative wooden strips to form panels (Fig. 2).

Few rooms are so designed in the grouping of door and window openings that the wall and ceiling panels can be arranged symmetrically and still mate with each other. It is best to divide the ceiling evenly into panels, and group the wall panels according to openings, or else make them fit the ceiling panels regardless of the openings.

Since all wallboard edges must have solid backing, an inexpensive job consists

(Continued on page 123)

This month's Home Workshop will be found on pages 71, 72, 76, to 127, and 131 to 134; The Shipshape Home on pages 128 to 130, and The Better Shop Methods on pages 74 and 135 to 145.

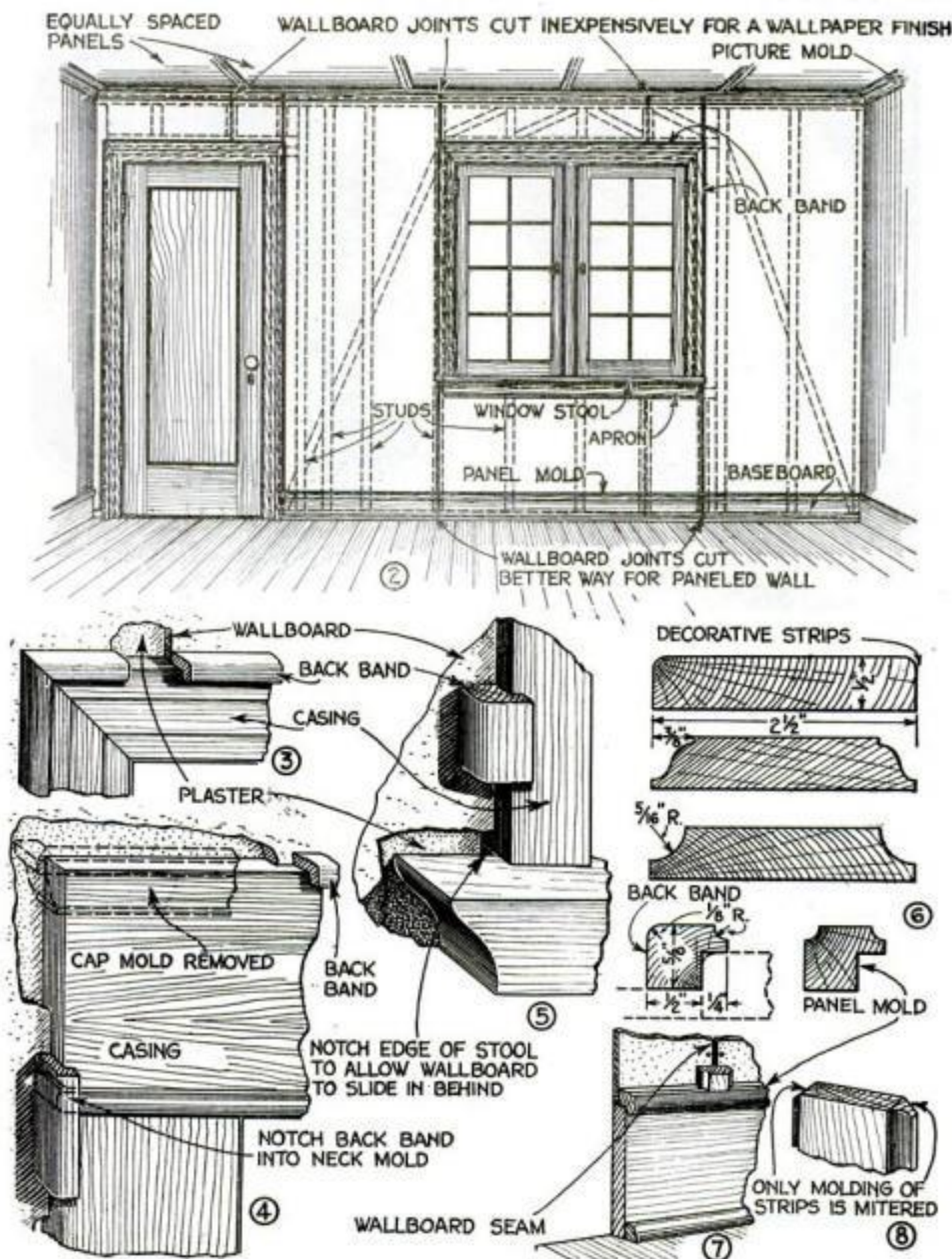


Fig. 2 is a typical wall elevation. Figs. 3, 4, and 5 are details of the trim. Fig. 6 gives molding profiles. Fig. 7 illustrates the base. Fig. 8 shows the end of panel strip ready for joining

Is Your Heating Plant Ready?

How to Put It in Shape for the Coming Winter

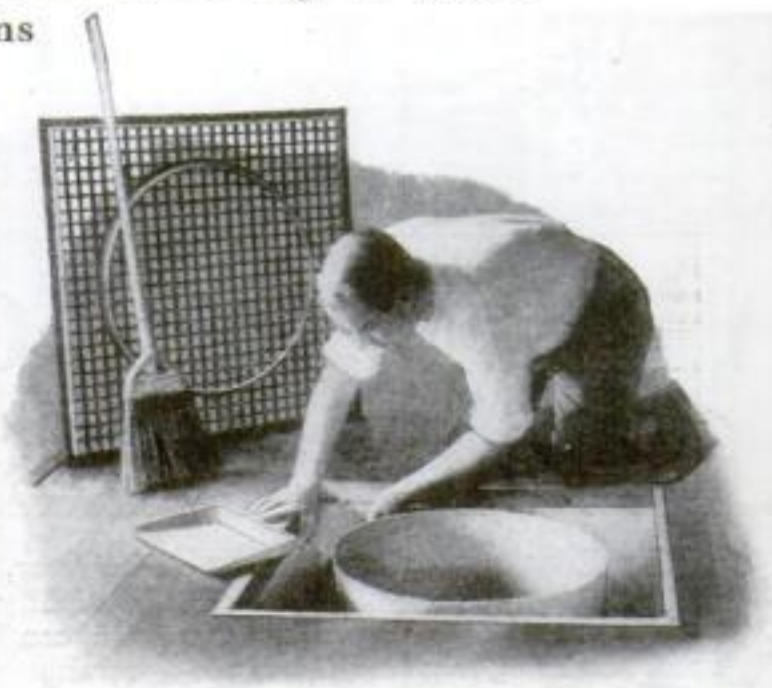
By Lawrence B. Robbins



Unless it was removed and cleaned in the spring, take down the smoke pipe, rap it with a stick to loosen the accumulated scale, and then scrape or brush out all the soot



The end of the smoke pipe should not project into the chimney more than the width of a single brick



The register box of a "pipeless" furnace is a dust catcher and should be cleaned thoroughly. Small registers and air pipes should be dusted every few years



Any section of the smoke pipe that is badly rusted or contains holes should be replaced. Wire the smoke pipe securely so that there will be no chance of the joints' opening

At right: Many a firebox is left full of ashes through the summer. It must be cleaned out thoroughly so the grates can be inspected



Open all clean-out doors and remove soot and scale with a long handled wire brush and a small, flat scraper. A special flue brush can be purchased or a wire handle can be attached to any small bristle or wire brush



Broken asbestos insulation should be patched with a paste of asbestos meal and water



Cover steam or hot-water pipes with asbestos paste or cellular insulation



If any of the grate bars are burned or broken, they should be replaced with new ones; not a difficult job

BY HAVING your boiler or furnace thoroughly clean, even to the most inaccessible places, you can save anywhere from one-half to four tons of coal a season.

It is advisable to dust between the radiator sections and even to remove the outer casing of a hot-air furnace, so that

the heating surfaces can be well brushed. The cold-air box should be cleaned and the air-inlet screen freed from rubbish.

If you have a hot-water or steam plant, drain off the water until it runs clear. If there is much sediment, empty and flush the boiler.

A steam boiler should be refilled until

the gage is half full with water; in a hot water system, until the gage on the expansion tank shows one-quarter or one-third full.

Joints between the castings of the boiler should be pointed when necessary with furnace cement. Examine all control valves, and test the safety valve.

WANTED: Men to Keep Pace with R.B. Cook

In 1919 R. B. Cook was a bookkeeper—holding down a one-track job. In 1923—four years later—he was sales manager of the B. A. Railton Company, Chicago; and ever since that time has successfully directed a sales force of more than seventy salesmen, many of them with twenty years' experience.

"To the casual observer," writes R. A. Railton, General Manager of the B. A. Railton Company, "his rise might seem unusually rapid, but we view it as the natural result of his being prepared for the big opportunity when it came."

CHICAGO



When a young man can advance in four years from a routine job to the position of Sales Manager of one of the big wholesale houses of Chicago—without any pull except his own initiative—there must be a reason. There is a reason. It's summed up in the LaSalle salary-doubling plan. What that plan has done for R. B. Cook it can do for any man sincerely ambitious to increase his earnings.

Advance, by this Plan, to Bigger Pay!

Here is the story of a pace-maker—a man who refused to let handicaps obstruct his progress—a man who acts and makes money by this simple principle: *to capitalize his every resource.*

Handicapped by ill health—which kept him in a hospital during four years of his boyhood—R. B. Cook, a Chicago man, bridged the gap in his education by day and evening study, which gave him a sound foundation for LaSalle home-study business training.

Starting as a bookkeeper, in 1919, he enrolled for LaSalle training in Modern Business Correspondence and Practice.

"Before I was half way thru my training," writes Mr. Cook, "I was promoted to Collection Manager, with an increase of 50 per cent in salary. Later I became Credit Manager of another concern. This move was a very decided promotion."

"My next advancement was to the position of Office Manager. In each of these positions I was successful. This fact paved the way to my present position. Two years ago I was offered a post as Assistant Credit Manager with my present concern. Within two years I was made General Sales Manager, which position I now hold."

Five years of *consistent progress*—that is the record of Mr. Cook, who has recently enrolled for LaSalle training in Business Management.

Paragraph by paragraph, line by line, he takes up each assignment, asking himself how he can turn each business principle into profits for his company. A single idea—so he writes—which he got from his very first assignment—resulted in savings of many thousands of dollars for his firm.

Send for Salary-Doubling Plan

You are eager for success. You wish to enjoy the rewards which come inevitably to the man who fits himself for responsibility.

But before you can reap those rewards, you must make yourself more profitable to the business which employs you. By no other method can you possibly succeed.

Cook's experience clearly shows the way—a way illuminated by the careers of thousands of LaSalle-trained men. During only six months' time, for example, as many as 1,248 LaSalle members reported definite salary-increases totalling \$1,399,507, an average increase per man of 89 per cent.

The details of the LaSalle *salary-doubling plan* will be sent you for the asking. Whether you adopt the plan or not, the basic information it will place in your hands, without cost, is of very real and definite value.

Balance the two minutes that it takes to fill out the coupon against the rewards of a successful career—then clip and mail the coupon NOW.

"Worth More Than \$10,000"

(—So writes R. B. Cook, the employee)

"The advancement I have made during the past five years to my present position as Sales Manager of the B. A. Railton Company was made possible thru your splendid training and the various services which I have used with much profit. Two years ago I wrote you saying that I would not part with the knowledge LaSalle training has brought me for \$10,000. Today I can say that I would not part with it for several times that amount."

(Signed) R. B. COOK, Chicago.

"You Are Rendering Our Organization a Distinct Service"

(—So writes R. A. Railton, the employer)

"In training a half million men, your institution has made a valuable contribution to business. You have added millions to the wealth of the annual earnings of your student members. Their increased productive capacity in turn is adding many millions to the business of the institutions which they serve. I feel that in bringing to our attention a man with the training and capabilities of Mr. Cook, you are rendering our organization a distinct service."

(Signed) R. A. RAILTON, Chicago.

LA SALLE EXTENSION UNIVERSITY

The World's Largest Business Training Institution

LA SALLE EXTENSION UNIVERSITY

Dept. 1083-R

Chicago

I shall be glad to have details of your salary-doubling plan, together with complete information regarding the opportunities in the business field I have checked below. Also a copy of "Ten Years' Promotion in One," all without obligation.

☐ **Business Management:** Training for Official, Managerial, Sales and Departmental Executive positions.

☐ **Modern Salesmanship:** Training for position as Sales Executive, Salesman, Sales Coach or Trainer, Sales Promotion Manager, Manufacturer's Agent, Solicitor, and all positions in retail, wholesale, or specialty selling.

☐ **Higher Accountancy:** Training for position as Auditor, Comptroller, Certified Public Accountant, Cost Accountant, etc.

☐ **Expert Bookkeeping:** Training for position as Head Bookkeeper.

☐ **C. P. A. Coaching for Advanced Accountants.**

☐ **Law:** Training for Bar; LL.B. Degree.

☐ **Commercial Law:** Reading, Reference and Consultation Service for Business Men.

☐ **Traffic Management—Foreign and Domestic:** Training for position as Railroad or Industrial Traffic Manager, Rate Expert, Freight Solicitor, etc.

☐ **Railway Station Management:** Training for position of Station Accountant, Cashier and Agent, Division Agent, etc.

☐ **Banking and Finance:** Training for executive positions in Banks and Financial Institutions.

☐ **Industrial Management:** Training for positions in Works Management, Production Control, Industrial Engineering, etc.

☐ **Modern Foremanship and Production Methods:** Training for positions in Shop Management, such as that of Superintendent, General Foreman, Foreman, Sub-Foreman, etc.

☐ **Personnel and Employment Management:** Training in the position of Personnel Manager, Industrial Relations Manager, Employment Manager, and positions relating to Employee Service.

☐ **Modern Business Correspondence and Practice:** Training for position as Sales or Collection Correspondent, Sales Promotion Manager, Mail Sales Manager, Secretary, etc.

☐ **Business English:** Training for Business Correspondents and Copy Writers.

☐ **Commercial Spanish:** Training for position as Foreign Correspondent with Spanish-speaking countries.

☐ **Effective Speaking:** Training in the art of forceful, effective speech, for Ministers, Salesmen, Fraternal Leaders, Politicians, Clubmen, etc.



Name..... Present Position..... Address.....

Better Shop Methods

How Expert Mechanics Save Time and Labor



By Charles Kugler

SUGGESTIONS for punch and die making as outlined in this article are the result of the writer's 30 years' experience as a mechanic. Some of the kinks, so far as the author knows, have not been published before.

In the first part the methods described can be used only in shops that have the proper equipment for this class of work. In the latter part the methods are those useful in shops where the equipment is inadequate or obsolete.

The rules to be given are not iron-clad. The author has in mind an average mechanic and an average job. If your shop has a die-filing machine and a vertical shaper, as well as other good tools, and you have to make a punch and die for such a part as the steel stamping $\frac{1}{8}$ in. thick, represented by the templet shown in Fig. 1, you can proceed as follows, bearing in mind that this example has been chosen because it allows so many points to be illustrated clearly and not because it represents an economical design from a production standpoint:

FIRST, plane or machine the punch, die, stripper, punch pad, and shoe. Grind one side of the punch pad and blue it.

If one has not already been provided, make the templet (Fig. 1) and scribe its outline carefully on the blued surface of the punch pad (Fig. 3). Then assemble the four parts as in Fig. 2. Two $\frac{1}{8}$ -in. parallels should be placed as shown between the die and shoe for clearance when boring the 1-deg. taper hole in the die. Carefully drill

Punch and Die Making

Secrets of Success in a Type of Work Machinists now Encounter Frequently

and ream dowel-pin holes and drive dowel pins in tight.

The work now is ready to be strapped on the faceplate of a lathe for boring out the four 1-in. holes, as shown in Fig. 4. Carefully indicate the center punch mark and drill and bore one hole; then remove the punch pad and stripper and make the hole in the die taper $\frac{1}{2}$ deg. on a side. Assemble again and proceed similarly with the other three holes. I remove the punch pad and stripper by prying them apart with a thin chisel without removing the dowel pins or disturbing the setting of the work, but other mechanics provide setscrew holes for forcing them off, which lessens any likelihood of the work's being damaged.

Remove the work from the lathe and, after applying a solution of sulphate of copper or blue vitriol on each of the parts, carefully scribe the outline of the templet on them.

The filing machine (Fig. 5) is used to saw out the core, leaving about $\frac{1}{32}$ in. for machining.

Now that the core has been removed from the punch pad, stripper, die, and shoe, assemble these parts again as in Fig. 6 and clamp them on the table of the vertical shaper. Carefully line up the outline on the stripper with the ways of the machine and shape the stock until you have split the line. If this is done properly you need not touch the work at all with a file.

Remove the punch pad and stripper, tilt the ram of the machine $\frac{1}{2}$ deg., and proceed to shape the die for clearance. The writer shapes through the die and shoe in this operation, since the opening in the shoe must be a trifle larger.

Drill the hole in the die for the stop pin, as shown in Fig. 8. The die now is ready to be hardened.

If the steel can be hardened in oil, and a gas furnace and pyrometer are available, there is little danger in the hardening process. If the steel must be hardened in water, however, care must be exercised. Heat the steel slowly and, in the absence of a pyrometer, place a few pieces of the

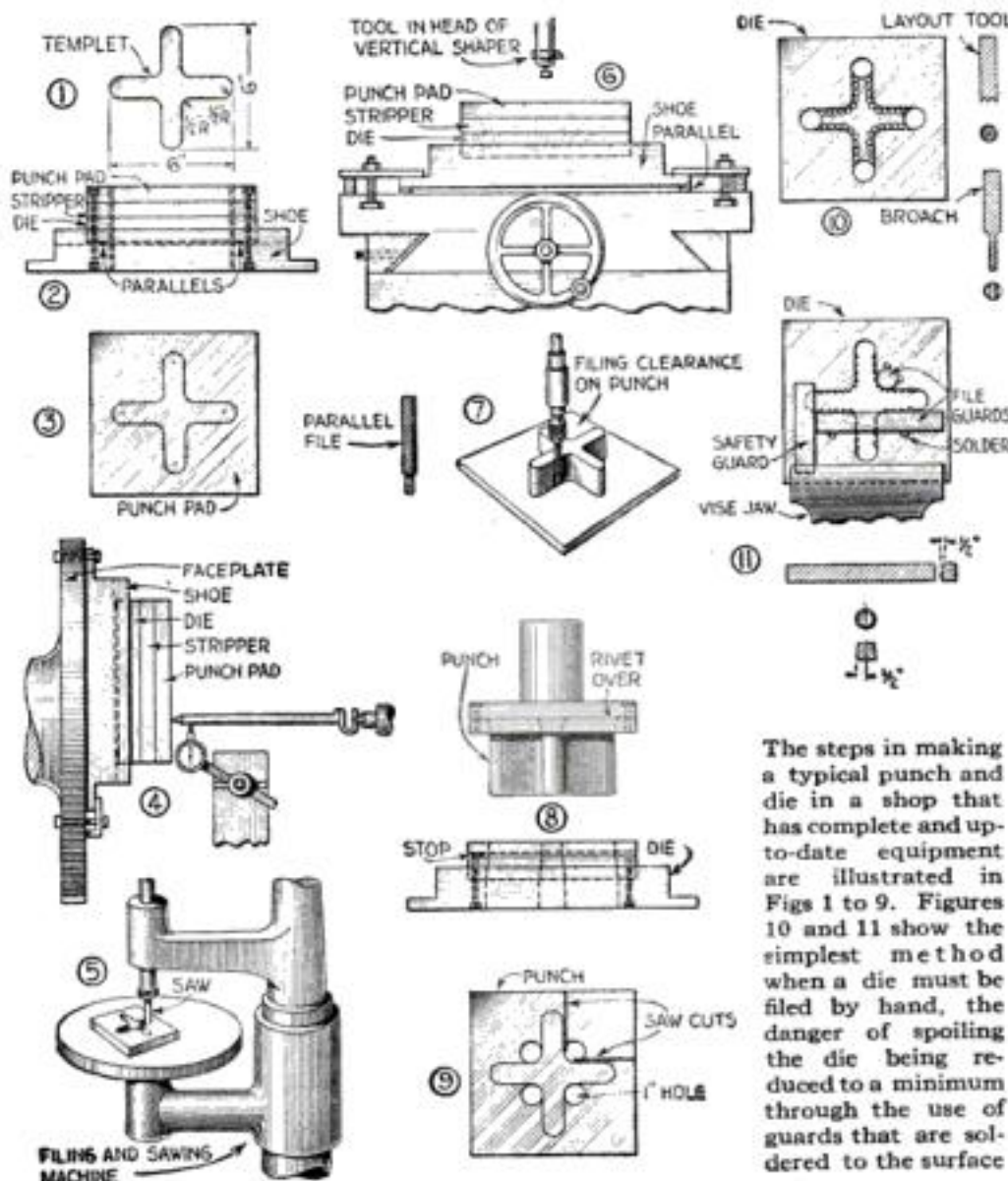
same steel in the furnace for use in testing. When you think you have the proper heat, quench one of these pieces and test with a file. In any case, see that all the holes in the die not to be used for cutting metal are plugged up with clay or asbestos.

AFTER the die is hardened, it should be polished on the top and the temper drawn to about straw color. This can be done in the furnace or on a hot plate. If an oil tempering-tank is at hand, it is only necessary to heat the oil to about 450° F. and leave the die in the oil until it attains this temperature. In this case no polishing is necessary.

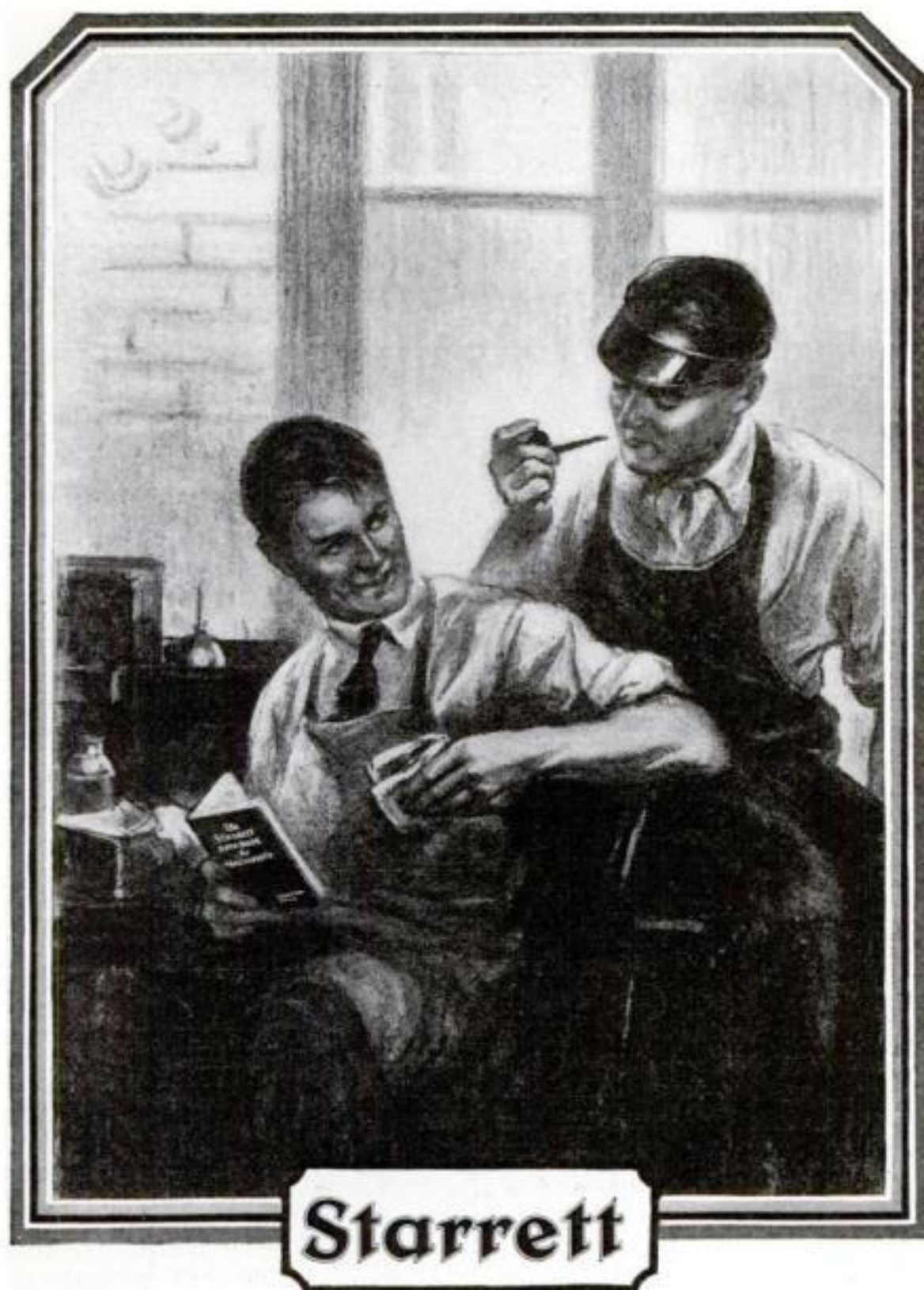
Grind the die on the top and bottom. The side of the die that is rounded should be ground last; otherwise rocking may cause difficulty.

(Continued on page 140)

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, which you will find on pages 135 to 145.



The steps in making a typical punch and die in a shop that has complete and up-to-date equipment are illustrated in Figs 1 to 9. Figures 10 and 11 show the simplest method when a die must be filed by hand, the danger of spoiling the die being reduced to a minimum through the use of guards that are soldered to the surface



Starrett

Handbooks, Vols. I, II and III

Are you interested in doing better work? If a beginner, do you want to know how to use your tools the way the best men in the shop use theirs? How to turn out work that's *right* the first time? How to size up and go through with a difficult job with no lost motion? Get Vol. I of the Starrett Books.

If you are a practical machinist, couldn't you use to splendid advantage a book which puts at your finger tips important formulas and technical dope—tables that relate to machine speeds, power transmission, drilling, gear cutting, turning and milling, materials,

etc.? Get Vol. II of the Starrett Books. If you work on cars and parts, wouldn't you appreciate a clearly written, well illustrated book that covers the latest and most approved methods and general practice in automobile and engine repair work? Get Vol. III of the Starrett Books.

The famous Starrett Handbooks give you this information. Profusely illustrated, approximately 200 pages of well printed text written for the man in the shop. And all for only 75 cents each. Send us that amount, if hardware dealer cannot supply you.

Catalog No 23-"W" sent free on request.

THE L. S. STARRETT CO.

World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
Steel Tapes—Standard for Accuracy
ATHOL, MASS.

Who
Is The Man
That
Gets Ahead



75¢
Each



Take a Tip from the Home Workshop Department

YOU will find scores of uses for hand clamps in your home workshop and for the hundreds of odd jobs that should be done around the house.

With Jorgensen Adjustable Hand Screws in your tool chest, you will find scores of jobs that bothered you before can be held together in exactly the position you want with a few turns of the screws.

The steel screws in the Jorgensen Clamps do away with the warping, swelling, sticking trouble and breakage of wooden screw clamps. The Jorgensen Clamps can be adjusted to any angle, thus doing away with the nuisance of squaring up irregular surfaces which other clamps require.

The spindles and sockets are made of fine quality steel and the jaws of seasoned maple. The Jorgensen is a beautiful, useful tool.

Take a tip from the Home Workshop Department of Popular Science Monthly and include hand screws in your tool equipment. It will give you more thumbs and fingers to work with—and you know how often you have wished you had a third hand when you have been gluing wood pieces, or doing other jobs that required the holding together of wood or metal pieces.



FITS ALL SHAPE JOBS

As a user of tools you will recognize the convenience of a hand screw that can be adjusted to whatever angle is required by the job you are doing. It comes in 12 sizes and can be used on hundreds of different jobs. Mail the coupon to-day for the Descriptive Circular—and, we suggest, order at least one clamp to learn by first hand experience the ease of doing jobs with Jorgensen Clamps.

Adjustable Clamp Co.

Manufacturers of the

"JORGENSEN"

STEEL SPINDLE HAND SCREWS

212 N. Jefferson Street, Chicago

Money Refunded if Unsatisfactory

ADJUSTABLE CLAMP CO.,
212 N. Jefferson St., Chicago

- Please send items checked below:
- ☐ Ship by mail, postage prepaid, ONE No. 5-0 Jorgensen Hand Screw (Length 4 in., Jaw opening 2 in.) for which I enclose \$1.00.
 - ☐ Ship by mail, postage prepaid, ONE No. 0 Jorgensen Hand Screw (Length 8 in., Jaw opening 4 1/2 in.) for which I enclose \$1.50.
 - ☐ Send latest descriptive bulletins.
- Money will be refunded if tools are unsatisfactory and are returned within 30 days.

Name.....

Address.....

The Home Workshop

Fitting Up an Attic Room

Second Article in a Series on Reclaiming Waste Space in Your House—The Walls

FLOORING laid, the next task in the building of an attic room is the raising of walls. Figure 4 gives the layout of the typical room described in these articles.

The bottom plates, of 2 by 4 in. stock, sized to thickness and width, are tacked in place about the room, the end lengths running the full width of the floor joists and the others cutting in between.

That no mistakes are made, it is well to check measurements by plumbing down to the floor from the ridge, the width being measured from the center line.

Since only the appearance of the inside is considered, the room corners should be made square, even though the floor joists may have been inaccurately placed. When the ends of the plates have been



This model shows how the 2 by 4 in. wall studs are set up

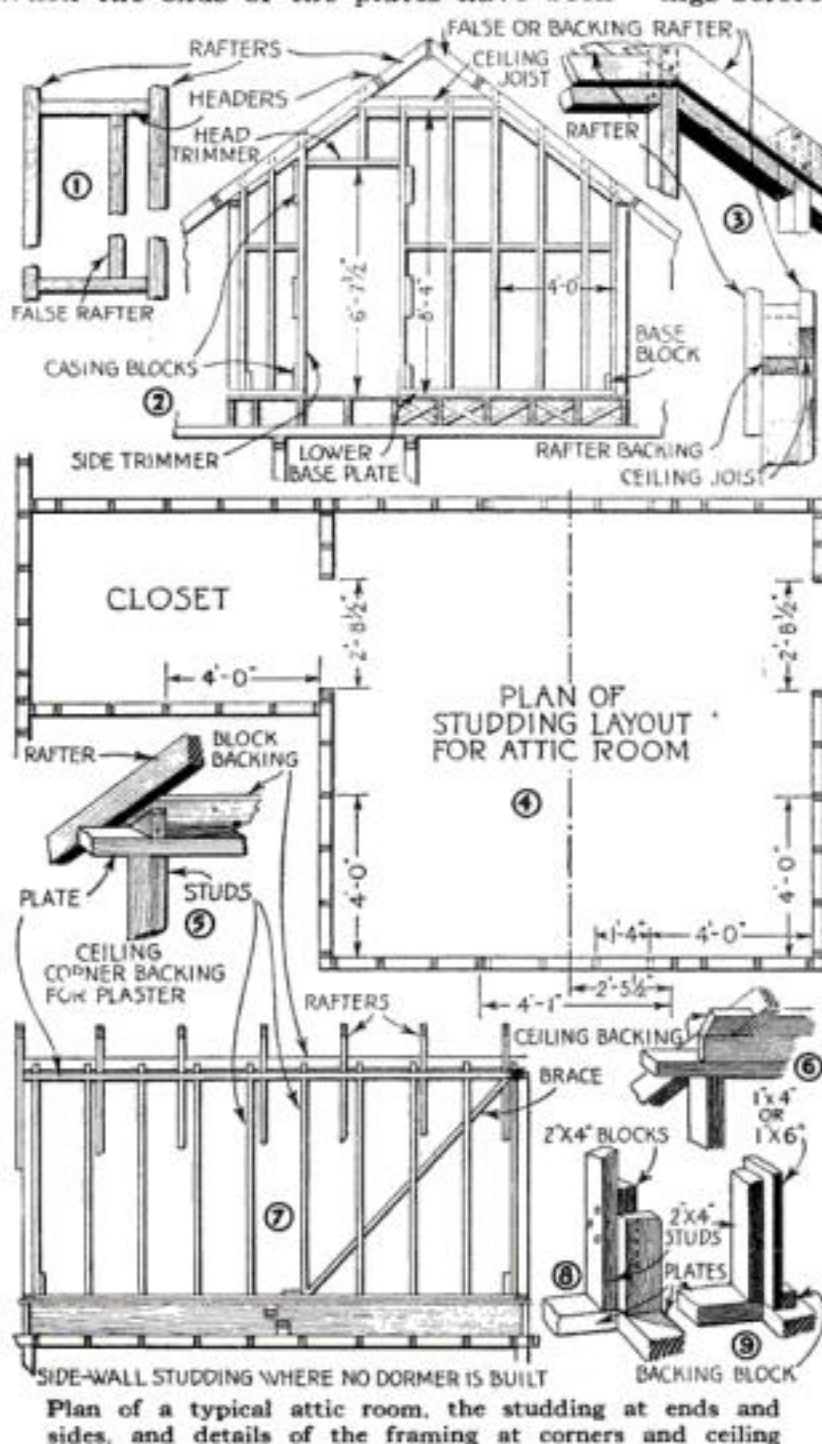
fastened, straighten them to a stretched line, by toe-nailing from the edges with eightpenny common nails wherever there is a kink. Then spike through them into the joists. Avoid driving nails through the plate at the door openings as the plate has to be removed from these openings before the door frames are placed.

The entrance-end partition (Fig. 2) is laid out as follows: Measure from the corner 4 ft., locating the center of the fourth stud. Allowing 2 in. for thickness, lay off distances of 16 in. from edge to edge in both directions, placing a corner stud as shown in the corner detail (Figs. 8 and 9).

If a pair of rafters happens to be spaced so that, when plumb, the studding edges will bear against them, they may be used as supports for the upper ends of the studs; but in all likelihood it will be necessary to "head across" between rafters to carry the false rafters shown in Fig. 1. This is done by nailing a piece of 2 by 4 between the rafters above the ceiling and below the wall intersection, to which the ends of the false rafter can be spiked (Fig. 3). This rafter forms corner backing for the ceiling fiber or plaster wallboard.

Instead of using two studs at the corners (Fig. 8), one stud with a backing of a 1 by 4 in. or 6 in. board nailed solidly behind it, as shown in Fig. 9, may be used, but it is not as solid.

The door space is trimmed 2 ft. 8 1/2 in. wide (allowing 2 1/2 in. for plumbing and



Plan of a typical attic room, the studding at ends and sides, and details of the framing at corners and ceiling

(Continued on page 126)

after all

"HOW WELL YOU CAN HEAR" is the only thing that really counts



FOR a few weeks after we get a new radio set we all have the "logged 57 varieties of stations last night" feeling in our blood. Then we get tired and want to sit back and have some real entertainment. For, after all, "How well you can hear" is the only thing that really counts—no matter whether the entertainment is coming from a local station or one a thousand miles away.



Acme M A-2 Audio Frequency Transformer—more amplification without distortion.

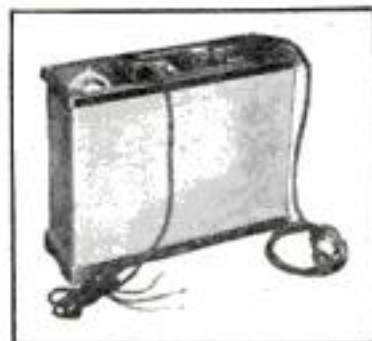
"How well you can hear"

IN THIS "how well you can hear" proposition is where quality comes in—and so does Acme. The

Acme Apparatus Company, pioneer radio and transformer engineers and manufacturers, have long made both transmitting and receiving apparatus of only the highest efficiency. Specialists in amplification, even before the days of broadcasting, this company has perfected "amplification without distortion."

Make this test with your set
DISTORTION does not mean merely squeals and

howls. *Any thing which fails to give you an exact reproduction of the human voice is distortion.* Here is how you can test your own set. Start your radio and at the same time keep up a conversation with two or three friends.



Acme B-eliminator for elimination without distortion.

Unless you can understand the voice over the radio as easily as that of a friend several feet from you, and without any more concentration and effort than is ordinarily required in talking with him, then you have distortion.

The reason you have to concentrate when listening to a voice speaking over the ordinary radio (an action unnecessary in ordinary conversation) is simply this: the individuality of the voice is lost because distortion has blurred out the overtones which give this vitality and individuality. Monotones are always hard to understand.

The whole story of distortion and how it can be overcome is carefully and fully explained in "Amplification without Distortion," a book on radio reception which is invaluable because it is written by a famous radio engineer in language even the radio novice can completely understand. Over two hundred thousand radio enthusiasts can vouch for the service it will give you. Thousands have written us their thanks. The 9th edition is just off the press. Send for your copy.

Claude F. Cairns

CLAUDE F. CAIRNS

President, Acme Apparatus Co.



Acme "Double Fre-edge Cone" Loud Speaker—for reproduction without distortion.

9th edition of this famous book just off press
—send for your copy.

A 40 PAGE book—over 200,000 of which have been sold at 10c a copy—gives the complete story of "Amplification without Distortion." Use coupon.



ACME

~for amplification

ACME APPARATUS CO.,

Dept. P2, Cambridge, Mass.

Enclosed find 10c (coin) (stamps) to cover mailing of one copy of 40 page book, "Amplification without Distortion."

Name

Street

City

State



File your next saw with a **PLUMB**

And you will then know both ease and speed of filing.

Plumb Files are of special taper, perfectly cut with keen edges that stand up. The edge of a Saw File is the life of the File.

Three Files do all your work:

The 5½" for fine Saws 10 to 12 point where a short stroke is all you can use.

The 7" is designed for a long sweeping stroke. Use this on your 6 to 10 pt. Saws.

The 8" is for your largest Saws. Use with a rigid stroke.

Plumb design, steel, cutting and temper solve your filing troubles.

Try your hardware dealer. If he does not have them send 75c (stamps will do) and we will mail you all three Files at once.

Fayette R. Plumb, Inc.
4818 James St., Philadelphia



5½ in.
20c

7 in.
25c

8 in.
30c



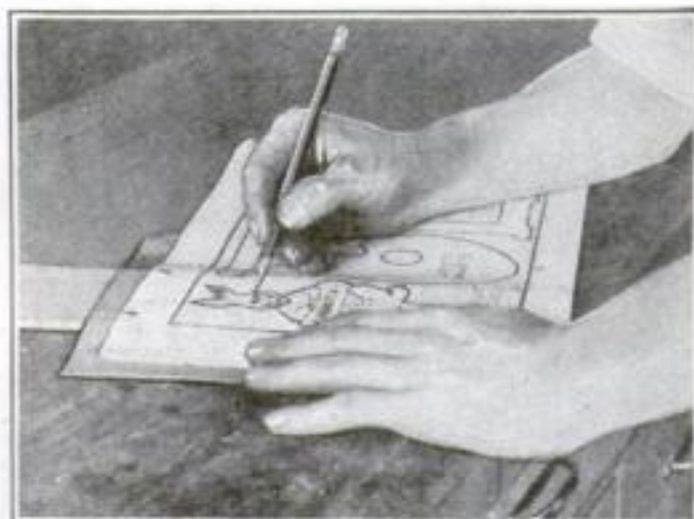
The Home Workshop

How to Use a Coping-Saw Marking and Cutting Fretwork

By Emanuel E. Ericson, *Noted Manual-Training Authority*



1 A coping-saw is used for cutting toy parts from thin wood, for making fretwork and overlays for furniture, for fitting moldings together, and for many similar purposes. The simplest type of coping-saw is shown above. The blade is inserted so that the teeth cut when the saw is pulled downward



2 To transfer a pattern on the wood or other material, place a sheet of carbon paper face down between the drawing and the stock, and fasten with thumb-tacks or nails, so that there will be no danger of the pattern's shifting. Trace the outline very carefully with a sharp, hard pencil or any pointed instrument

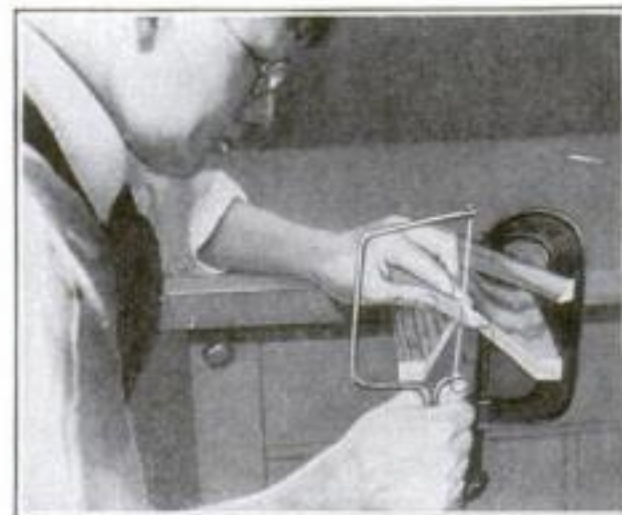


3 The simplest type of sawing-table or "saddle" is a board with a V cut, which is clamped to the edge of a bench or table

4 Below: Lay the wood on the "saddle," grasp the saw handle firmly, and saw on the down stroke. Turn the saw or the wood, or both, so as to follow the outline, and cut on the waste side of the line. When necessary, the blade may be set at right angles to the handle



5 When an inside cut is to be made, a hole is drilled so that the blade can be inserted in it before being fastened in the frame. For cutting fretwork of large area, use a bracket saw frame, as it is much deeper from blade to back



6 Moldings are "coped" to join each other at a right angle by cutting a miter at the end of one piece and sawing through the line where the miter and the face of the molding intersect. The abutting molding is not cut at all



*Whether you smile or cuss
depends upon the service
behind your Radio~*

WHAT is this radio service which we claim is so necessary?

Do you drive a car?

Do you ever have little things go wrong with it?

You have become so used to minor troubles that you don't condemn the car on which they occasionally occur.

No—

You go right to a service man—a man who knows your make of car. You don't go to a handy man who claims he can fix any car.

That's automobile service, and is one of the main reasons for the auto being the success it is today.

The same service condition exists in radio—the only difference being that people don't yet understand it.

The radio instrument which never requires service has never been built—it never will be.

Like automobile manufacturers, the better radio manufacturers do all within their power to make their instruments mechanically perfect. Nevertheless, like the auto, little things will sometimes go wrong—they are serious to the radio owner but very simple to a factory trained service man.

The handy man who can fix any radio simply experiments until he locates the trouble—such a method was disastrous to the auto in former days—it is disastrous and expensive in radio today. It is not sound.

Ozarka instruments are sold only by Ozarka factory representatives, men who are factory trained in sales and service, men who sell no other radios but Ozarka.

These men don't pretend to know all about radio but they do know all there is to know about Ozarka—isn't that the kind of radio service you want?

Ozarka instruments are sold under a very definite plan. An Ozarka representative will gladly set up an Ozarka in your home—he won't tune it—he won't tell you what it will do—you must operate yourself. If the results you receive by your own operating won't convince you that the Ozarka gives you the distance, volume, selectivity, tone and ease of tuning that you demand then don't buy it.

Ozarka instruments are built to sell themselves but no Ozarka is sold without factory-trained service behind it.

Openings for a Few More OZARKA Factory Representatives

OZARKA Incorporated, is now entering its 4th year. From a beginning with one engineer, one stenographer, one salesman—our present president, the Ozarka organization has grown to over 3,100 people. There must be some good reason for this growth.

Ozarka instruments have made good—they have more than met competition. Ozarka representatives have made good not only because Ozarka instruments were right, but because they have been willing to learn what Ozarka engineers were willing and capable to teach them—Ozarka unusual salesmanship and Ozarka service.

There are still openings for the right men in this organization—men who believe in the future of radio—men who are tired of working for some one else—men who want a business of their own. Prove yourself by sales and willingness to learn and exclusive territory will be given you. The man we want has lived in his community for some time. He has the respect of his fellow men because he has never "put anything over" just to make money. He may not have much money, but he is not broke and is, at least, able to purchase one demonstrating instrument.

Send for FREE Book

Radio offers a wonderful opportunity to men who are willing to start at the bottom and build. You need not know salesmanship, but will you learn what we will gladly teach you? You may not know radio, but we can and will teach you if you will do your part. With such knowledge and willingness to work, it doesn't seem possible that you cannot make good. Sign the coupon below, don't fail to give the name of your county. Better still write a letter, tell us about yourself and attach the coupon. If interested in our salesman's plan ask for "Ozarka Plan No. 100."

OZARKA

120 Austin Avenue R
Chicago, Illinois



You'll Know the Man
Behind This Button!

INCORPORATED

120 Austin Avenue R
Chicago, Illinois

Gentlemen: Without obligation send book "Ozarka Instruments No. 200" and name of Ozarka representative.

10-25-120R

Name

Address City

County State

Gentlemen: I am greatly interested in the FREE book "The Ozarka Plan" whereby I can sell your radio instruments.

10-25-120R

Name

Address City

County State

Westinghouse Rectigon Battery Charger



The Rectigon recharges BOTH "A" and "B" batteries easily and quickly. There's no muss or fuss; no acids or chemicals to bother with—

No moving parts,
and no noise.

®

No storage-
battery radio
is complete
without a
Rectigon!

WESTINGHOUSE ELECTRIC &
MANUFACTURING COMPANY

South Bend, Indiana



The Home Workshop

How to Perform the Mystifying Thimble-Handkerchief Trick

By Kenneth B. Murray

PUSHING a thimble through a handkerchief is a neat, simple, and inexpensive little illusion that can be mastered quickly by any one interested in parlor magic. It never fails to astonish those who are not in the secret.

You show your audience an unprepared thimble and a small black handkerchief. Then you place the thimble on a finger of the left hand and cover it with the handkerchief. The next instant you appear to push and pull the thimble violently half-way through the handkerchief. After the audience has been duly impressed, you

pull it all the way through, immediately giving the undamaged handkerchief and the thimble to the spectators for examination.

How the trick is done is shown in the photographs below. Practise this illusion 15 times and you will be able to fool almost any one. The method is entirely different from that commonly used, which requires a thimble previously cut in two, and has the advantage that the hand pulling the thimble through the handkerchief can be shown entirely empty, as there is no half-thimble to be concealed.



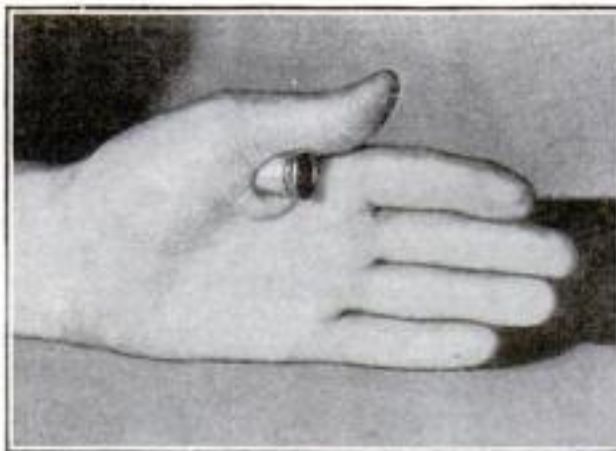
Purchase two thimbles and paint the lower part of one of them halfway around, using any good non-gloss, moisture-proof paint, black in color



Show the unprepared thimble and a small black handkerchief to the audience. Then place the thimble on the forefinger of your left hand and cover it with the handkerchief. Have the prepared thimble concealed in the right hand



Place right hand over form of first thimble, which shows through the handkerchief, and push the prepared thimble on it. At a short distance it will seem as if the thimble is sticking half-way through the handkerchief

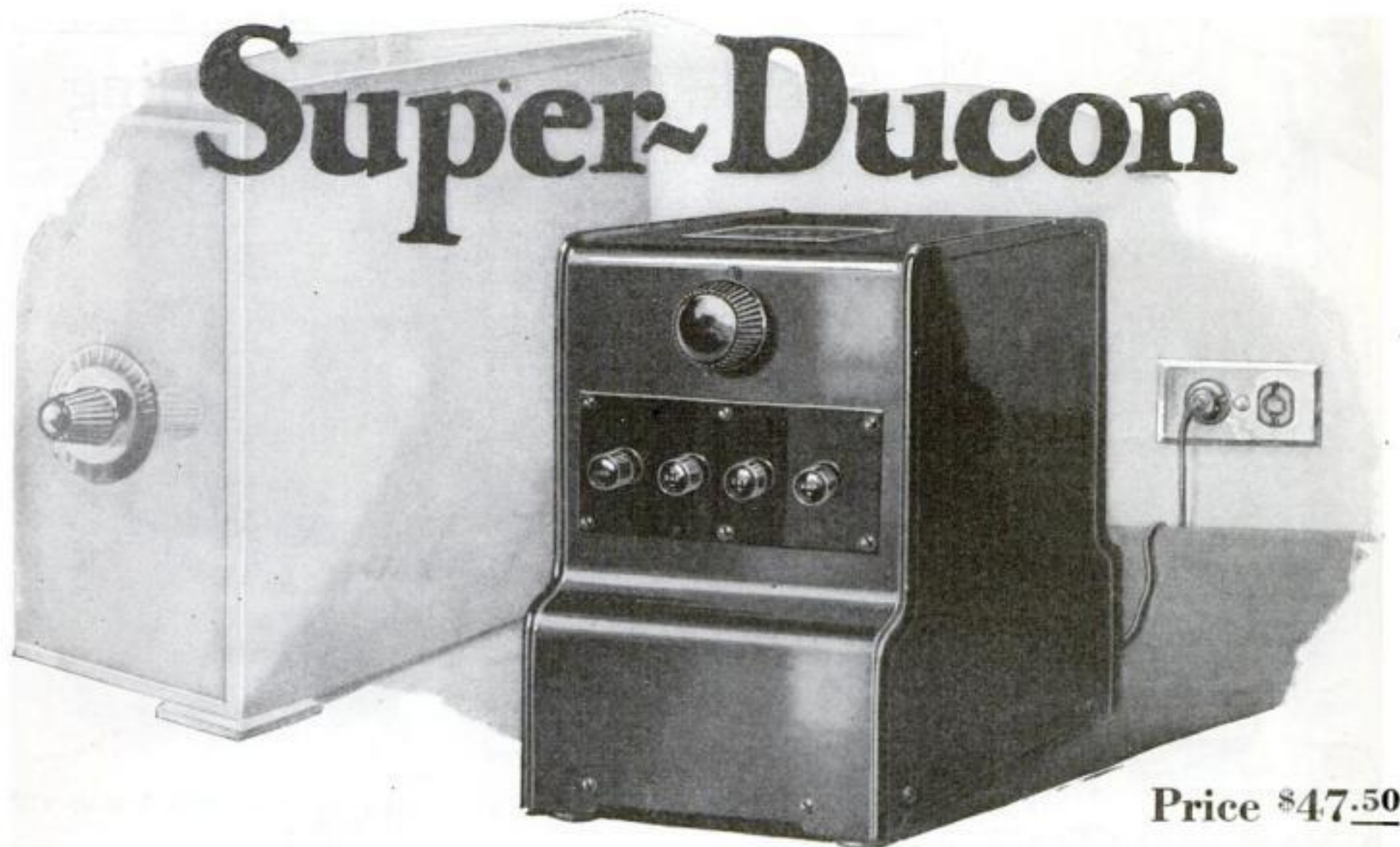


At the right: "How to palm or conceal a thimble." It is held lightly at the root of the thumb

Give spectators time to appreciate the feat and then pretend to pull the thimble entirely through the handkerchief by giving the prepared thimble a half turn so that painted part is at the back, as you remove it. Finally offer the plain thimble and the handkerchief for examination

NEXT in Mr. Murray's series of parlor magic classics is an article on how to make a new type of handker-

chief-vanishing apparatus. If you wish any special trick explained, the Editor will be glad to hear from you.



Price \$47.50

Perfected with specially designed **RCA Tube**

THE Super-Ducon replaces the "B" Battery, operates from the light socket (110 to 115 volts, 60 cycle A.C.) and is absolutely noiseless when properly installed.

Every radio man knows the results he gets when his "B" battery is at its best. The Super-Ducon gives him this top-notch volume *all* the time.

As now furnished, the Super-Ducon has a specially designed R C A tube—Rectron U.V. 196, which has an average life of more than 1,000 hours.

Tested and listed by the National Board of Fire Underwriters

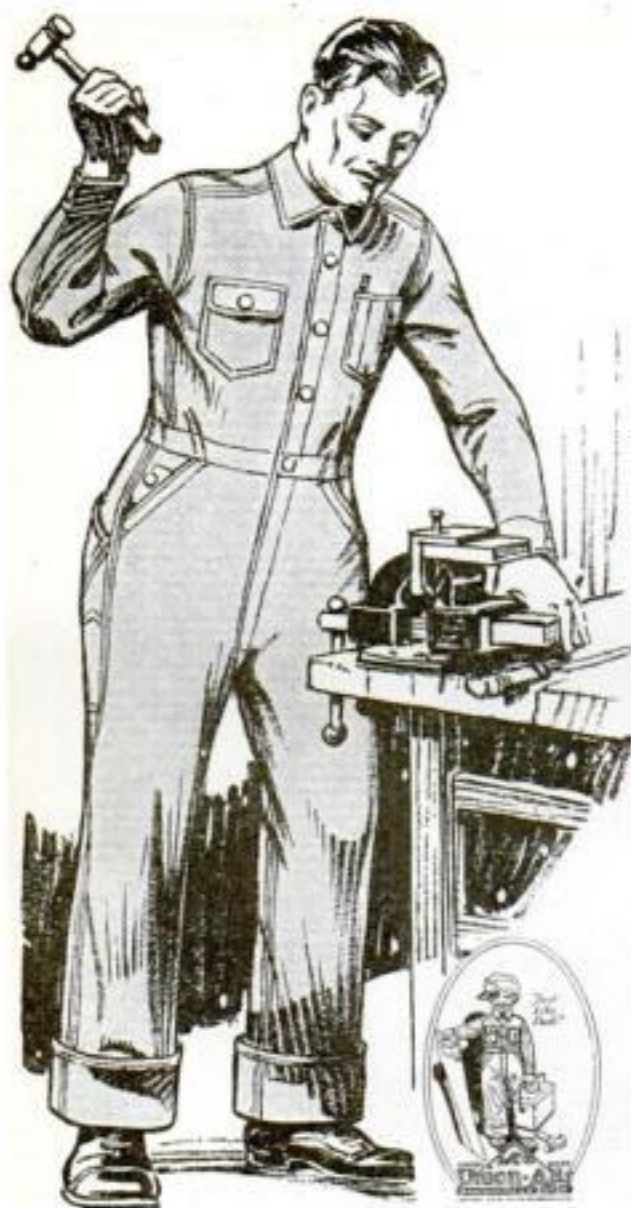
Write for descriptive bulletin.

Address: 4377 Bronx Blvd., New York City.

®

Dubilier

CONDENSER AND RADIO CORPORATION



A Necessary "Tool" For Your Workshop

FOR the man or boy who has a home workshop, Lee Union-Alls are a handy "tool" to have about. All that is necessary when you want to get busy is to slip into them and start your work. They cover the body from head to foot and can be worn over other clothing. They save clothes, also. And they save time where the hours for such work are limited.

Wear Lee Union-Alls, the original one-piece work suit, worn by thousands of mechanics, shopmen, garage workers and industrial workers. Lee Union-Alls are quality-built—close-woven cotton fabric, riveted rustproof buttons, reinforced strain points—fully guaranteed to give satisfaction. They give solid comfort, long wear, and are neat in appearance. Accept no substitute—look for Lee on the buttons. Thousands of live dealers sell Lee Union-Alls. Ask your dealer today!

Lee Union-Alls

THE H. D. LEE MERCANTILE CO.
Kansas City, Mo.

Trenton, N. J.
Minneapolis, Minn.

South Bend, Ind.
San Francisco, Cal.



Lee Overalls and Work Shirts are other items in the famous Lee line. They are quality-built, also.

The Home Workshop

Simple Cigar-Box Whittling

Pocket-Knife Is Only Tool Needed to Carve Attractive Patterns in Thin Wood

By Herbert I. Childs

THREE cigar boxes and a little spare time is the recipe for the ornamental box illustrated below.

It can be used for holding cigars or cigarettes, trinkets and odds and ends or, if lined with plush, as a jewel casket. There are, indeed, so many uses for it that you can be sure you will find it serviceable and, of course, it will make a most acceptable Christmas present.

It is much easier to make than the photograph might suggest at first glance. The basis is a cigar box. Whether you will need to take the original box apart, scrape the paper off, sandpaper it and re-assemble the pieces will depend upon what kind of a cigar box you have obtained and whether or not you intend to line the interior.

The ornamentation is built up in layers, each one cut $\frac{1}{2}$ in. smaller in size than the one below it. For example, if the original cover of the box is 6 by 8 in., the next section will be $5\frac{1}{2}$ by $7\frac{1}{2}$ in., the next, 5 by 7 in., and so on, until you have obtained the thickness you desire.

With a ruler divide each edge of each section with lines $\frac{1}{2}$ in. apart. Then between each of the marks cut a V-shaped notch with your pocket-knife. These notches should extend in from the edge $\frac{1}{4}$ in. so as to bring the points of the notches to a line where they will meet the edge of the section above.

Your initials carved on the top section will look well, or the initials of the one



perhaps, for you to touch them up with fine sandpaper.

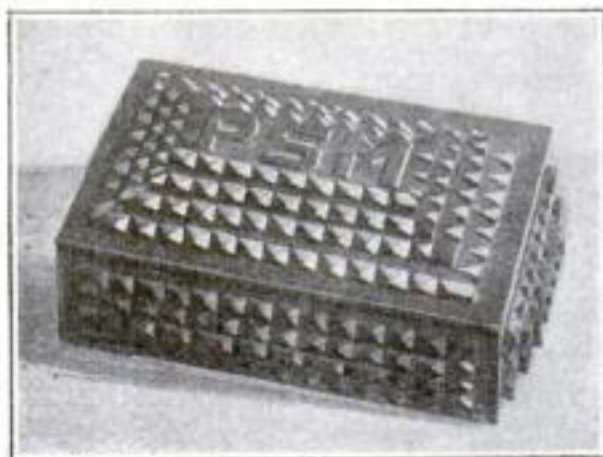
The sections are glued in place either with hot cabinet glue or a good grade of liquid glue, and a few fine brads can be used where they will not show, if care is taken not to split the wood.

Work of this kind does not require a highly polished, glossy finish. You may stain the wood, if it is not dark enough to suit your fancy, and either give it one or two coats of very thin shellac, or one coat of thin shellac and one coat of flat drying varnish or furniture wax, or merely a coat of genuine linseed oil and turpentine mixed half and half and applied warm.

There are five important points to observe in all whittling. Close your hand about your knife with the thumb over the fingers, as if to reinforce them—a good firm grip and yet not so tight as to cramp your hand. Always cut with the full length of the blade, if possible, drawing it from the heel to the point. Do not let your knife get dull. As soon as it begins to draw hard, sharpen it by the method described in my article last month. Always whittle away from you, if you can; you will cut faster, as well as insure yourself against accident. Do not use your knife as a screwdriver, a can-opener, or a hammer; countless good knives are spoiled through such misuse.

Put a drop of oil now and then on the spring end with the blades three-quarters closed. Dry joints are harmful to the knife in time and in many cases are a source of annoyance to the user because the blades will not close entirely.

TWO especially noteworthy articles for amateur mechanics are on the schedule for next month. One tells in detail how to use glue to the best advantage in the home workshop. The other is on fitting and hanging storm sash quickly and accurately.



An ordinary cigar box decorated with the simplest variety of pocket-knife carving

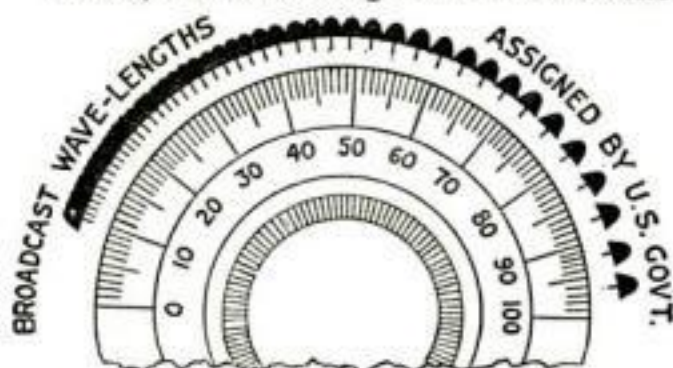
to whom you intend to give the box, if it is to be a present. Mark them carefully and cut away the surface so as to give a raised effect to the letters. There is no special rule to go by; in fact, one of the fascinating things about whittling is that you can do everything to suit your own taste.

As a rule, carving should not be sandpapered, as it is desirable to have the tool marks show to some extent; but if you have left any rough places, it will be well,

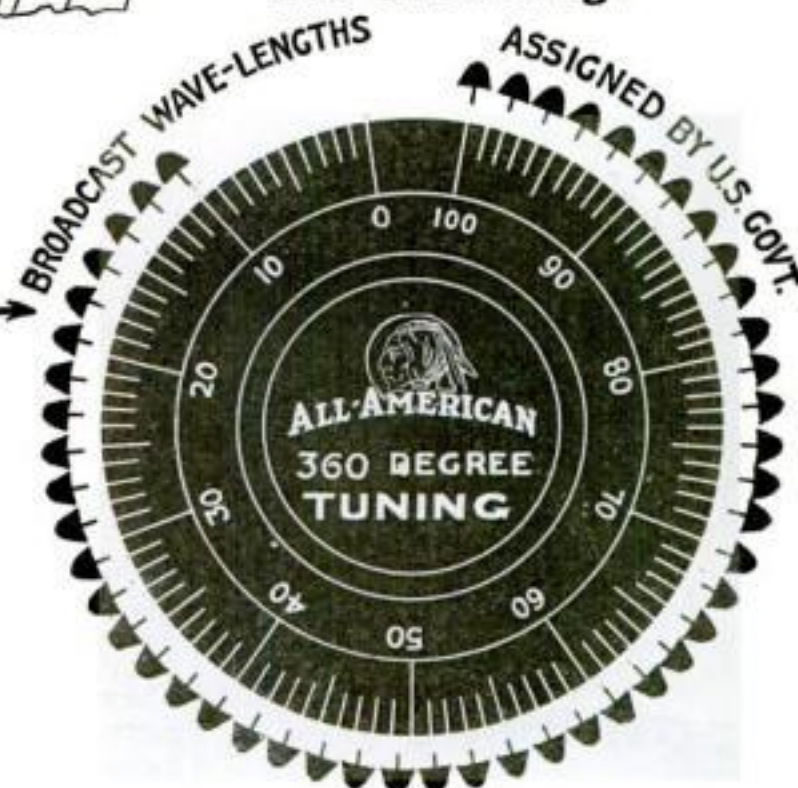
This Year —

Better, But Crowding Still Troublesome

Last Year —
Bad Crowding of Shorter-Wave
Stations



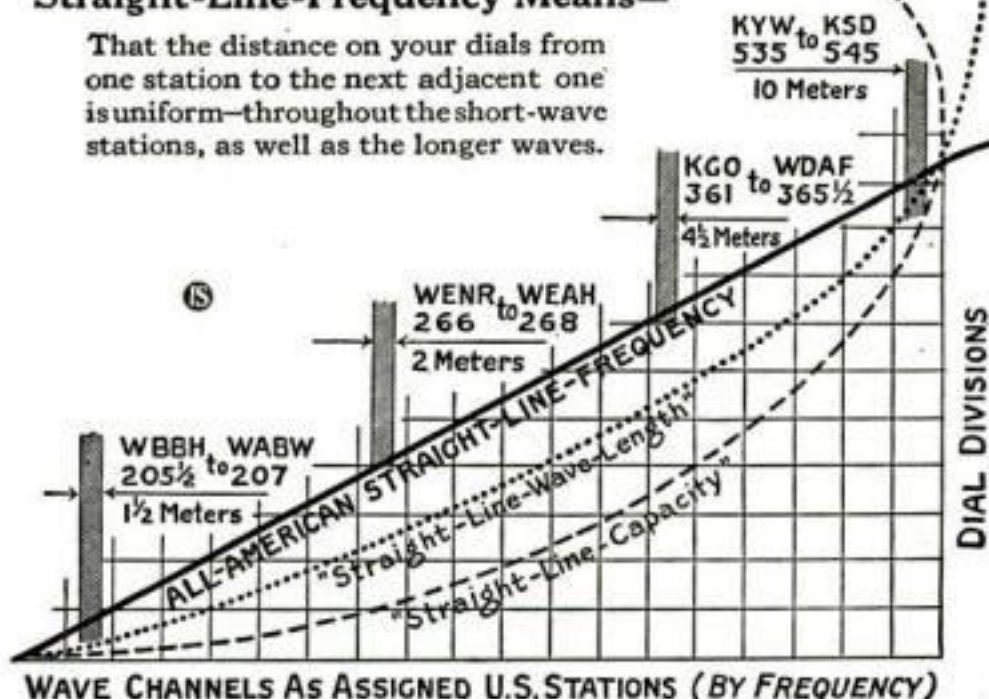
Next Year —
No Crowding!



20-KILOCYCLE INTERVALS ARE SHOWN
ALTERNATE CHANNELS OMITTED
FOR CLEARNESS

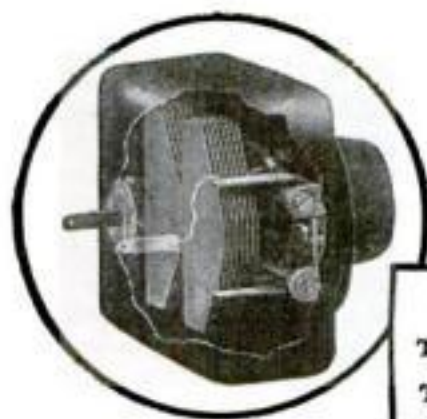
Straight-Line-Frequency Means —

That the distance on your dials from one station to the next adjacent one is uniform — throughout the short-wave stations, as well as the longer waves.

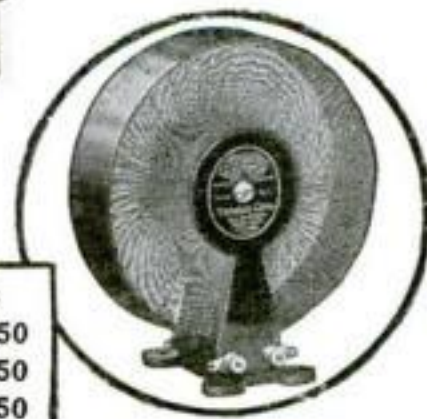


WAVE CHANNELS AS ASSIGNED U.S. STATIONS (BY FREQUENCY)

ALL-AMERICAN STRAIGHT-LINE-FREQUENCY TUNING



All-American Straight-Line-Frequency Condensers
Type C-35 Max. 350 micromicrofarads (Min. 10.5 mmf.) . . . \$4.50
Type C-50 Max. 500 micromicrofarads (Min. 11.8 mmf.) . . . 5.00



All-American Toroid Coils
Type T-1 Antenna Coupler \$3.50
Type T-2 R.F. Transformer 3.50
Set of 3 Coils complete . . 10.50

Ease and certainty in tuning — no more crowding of short-wave stations — no need to buy vernier dials — no gears or other back-lash makers — body capacity absolutely not distinguishable — electrical efficiency unsurpassed — on one-half the panel space: that is the ALL-AMERICAN Straight-Line-Frequency Condensers.

New power for distance reception through close coupling — tuning of arrow-like sharpness — elimination of all oscillation worries through the self-enclosed endless magnetic field — non-radiating reception: that is ALL-AMERICAN Toroid Coils — Antenna Coupler and Radio Frequency Transformers. See them at your dealer's.

A new edition of the famous RADIO KEY BOOK, together with complete information about the new ALL-AMERICAN Straight-Line-Frequency TUNING, is yours for 10 cents, coin or stamps. Send for it today sure!

ALL-AMERICAN RADIO CORPORATION, E. N. Rauland, President, 4215 Belmont Ave., CHICAGO

ALL-AMERICAN
Pioneers in the Radio Industry

The Home Workshop

Striking-Bag Mounted to Give Realistic Boxing Practice

WHILE it is unlike anything that can be found in sporting-goods stores, the method of mounting a striking-bag shown in the accompanying illustrations has advantages that immediately will be apparent to every athlete.

The ball rebounds at various angles from the slanting rafters and boards, so the boxer is afforded an opportunity to block, duck, side-step, and back-step, approximating actual boxing movements, instead of going through the usual monotonous drumming exercises.

The idea had its origin in improvising a striking-bag mounting in an attic, as in Fig. 1. The only materials needed for such a mounting are six boards. They are placed between the rafters to prevent the bag's being penetrated by any shingle nails that stick through the roof. The sharp corners of the three rafters against which the bag caroms are rounded to a radius of $\frac{1}{2}$ in. with a plane.

With rafters pitched at the usual angle there will be about 28 in. of rope between the loop in the bag and the swivel, if the bag is hung at about the height of the stomach, which is to be recommended.

An elaboration of the same idea, designed for a large training or recreation camp, is shown in Fig. 2. It is a four-bag platform. One bag is mounted in the



Fig. 1. Novel method of mounting a striking-bag in an attic. Only six short boards are required

usual style under a horizontal platform. A heavy sand bag is suspended from one end of the cross piece and a "double-end" is provided at the other end. The fourth bag is mounted as previously described.

Guy wires provided with turnbuckles can be substituted for the upright braces A and B and if a light "exhibition" bag is used under the platform, the triangular braces indicated at C-D will be sufficient.

Figure 3 shows an outdoor or straight wall platform for a single bag. In case a heavy "gym" bag is used, the back and ends should be boarded up to form a V-shaped trough, which should be filled with sand. The top should be covered with a sloping roof to keep the sand dry. The "two by four" from which the bag is suspended can be braced, if necessary, with triangular blocks screwed in place.—R. L. K.



Five Ratchet Adjustments
1. Plain Drill
2. Left-hand Ratchet
3. Right-hand Ratchet
4. DOUBLE Ratchet
5. Gears Locked

Drilling fender to install stop-signal, or parking light, one of the many jobs for which this handy little tool can be used.

Dwarf in size Giant in service

"Yankee" Hand Drill No. 1530 is the biggest, little tool you can own.

Only 10½ in. long. You can carry it in your pocket. Weighs but 1¼ pounds. Yet it has all the famous ratchet adjustments of the big "Yankee" Hand Drills and Breast Drills.

"YANKEE" Ratchet Hand Drill No. 1530

Works in places impossible for other drills, by means of five ratchet adjustments, controlled by just a finger touch on the ratchet shifter.

3-jaw chuck holds round drills up to 3/16 in.

Some other "Yankee" Tools

Ratchet Bit Brace Ratchet Screw-drivers
Ratchet Bench Drills Ratchet Chain Drills

Dealers everywhere sell "Yankee" Tools

"Yankee" on the tool you buy means the utmost in quality, efficiency and durability

Write for FREE "Yankee" Tool Book

NORTH BROS. MFG. CO., Philadelphia, U. S. A.

"YANKEE" TOOLS

Make Better Mechanics

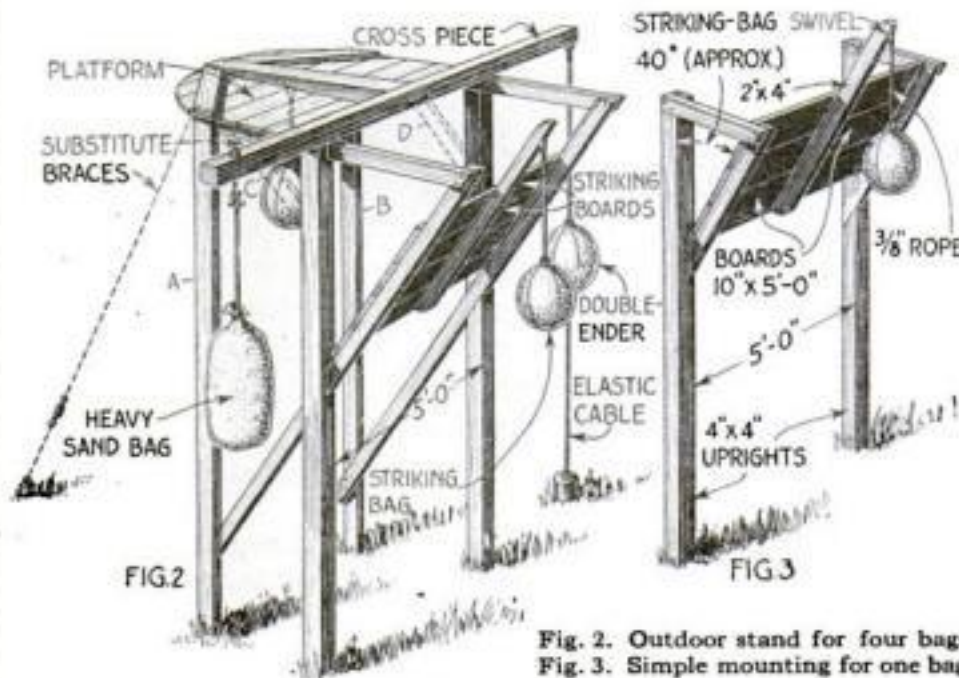


Fig. 2. Outdoor stand for four bags
Fig. 3. Simple mounting for one bag

Mixing Paint and Whiting to Make Putty

IN PAINTING about the house, small amounts of putty are required at intervals, yet if prepared putty is purchased in pound cans, it becomes hard and unusable in time. I find it is better to mix a little dry whiting with a bit of the paint that is being used. This can be done in a moment's time and the putty

then matches the paint in color. There is no waste, as only a sufficient amount for the job on hand need be mixed.

This method is especially desirable when flat-drying interior paints and enamel undercoaters are being used, because ordinary linseed-oil putty should not be used with them.—R. E. CHAFEE.



The slow 2-ampere battery charger is as obsolete today as the old "one-lunger" of 1903

Buy nothing but an up-to-date 5-ampere charger!

The New Improved
5 AMP. A & B
GOLD SEAL
HOMCHARGER
\$19⁵⁰



Over 500,000 already in use

Charges 150% Faster!

Better Because:—

New micrometer adjustment, hinged lid, and carrying handle.

No bulbs to buy or break.

Can be used anywhere—contains no acids or other harmful liquids to spill.

Approved by underwriters—trouble-proof, shock-proof and fireproof.

Beautiful cabinet in maroon and gold.

It takes only one-third as long to charge a battery with the New Improved GOLD SEAL HOMCHARGER. The big, healthy 5-ampere charging rate does away with the long bothersome waits that were necessary when the obsolete slow 2-ampere charger was the best that radio offered.

The New Improved GOLD SEAL HOMCHARGER charges 150% faster—will charge your battery overnight! And it charges both A and B batteries without additional equipment.

Don't let anybody sell you a slow 2-ampere charger—they are obsolete—out-of-date. You need a modern charger with a full 5-ampere rate. Insist on the GOLD SEAL HOMCHARGER.

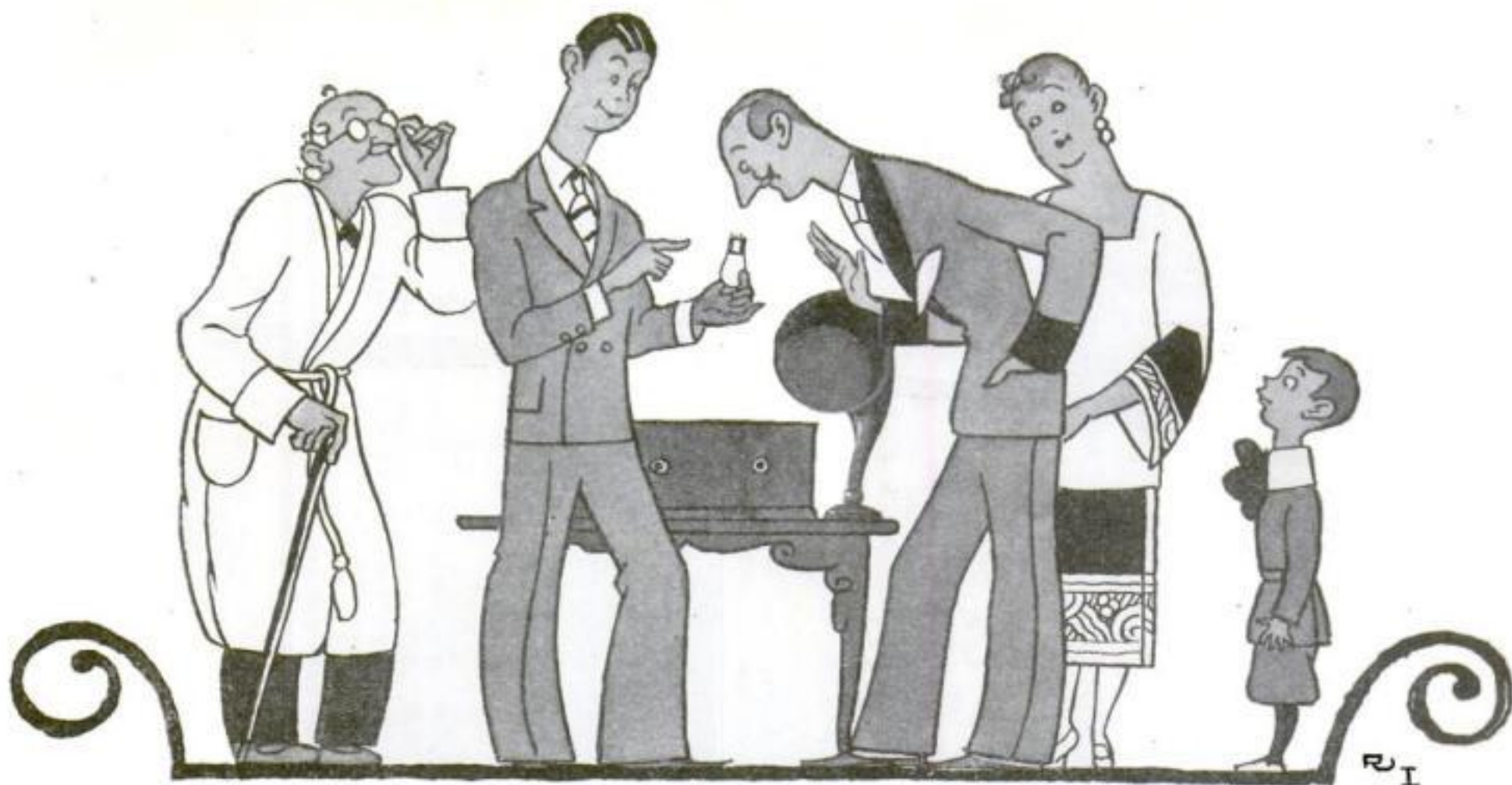
Free

Write for new edition of our instructive booklet on radio operation "The Secret of Distance and Volume in Radio."

The Kodel Radio Corporation
 500 East Pearl Street Cincinnati, Ohio



Owners of Kodel Broadcasting Station WKRC on the Alms Hotel. Send for program.



It's a *genuine* UV-201-A only when it bears the name Radiotron *and* the RCA mark



WD-11, WD-12, UV-199, UV-200, and UV-201-A are the type names of Radiotrons. They belong to Radiotrons only. To be sure you are buying the genuine, look for the name Radiotron and the RCA mark on the base. Then you are sure of quality.

®

Radio Corporation of America
Chicago New York San Francisco

Radiotron

REG. U.S. PAT. OFF.

AN RCA PRODUCT

The Home Workshop

Blueprints Will Aid You in Making Christmas Presents

WHAT are you planning to make in the way of furniture for Christmas presents? If you have in mind anything elaborate, the sooner you get your materials together, the better.



Bench (15) and Smoking Stand (2)

You will need first of all a trustworthy and carefully detailed working drawing and a complete bill of materials or cutting list, as woodworkers often call it. Just here the Home Workshop Department can be of real assistance to

you, for it offers you a wide range of blueprints—listed below—at the nominal price of 25 cents each.

Especially to be recommended for Christmas gifts are the sewing table (No. 1), the smoking cabinet (No. 2), the kitchen cabinet (No. 5), the tea wagon (No. 13), the workbench (No. 15), the cedar and mahogany chest (No. 17), and the radio sets (Nos. 41-43).

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to answer any specific questions relative to tools, material, or equipment. Blueprint Service Dept.

Popular Science Monthly
250 Fourth Avenue, New York
GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....cents:

No.	Title	Published	Price
1.	Sewing Table	Feb., '22	25c
2.	Smoking Cabinet	Mar., '22	25c
3.	End Table	Apr., '22	25c
5.	Kitchen Cabinet	May, '22	25c
8.	Shaving Cabinet	June, '22	25c
9.	Arbor, Gate and Seats	July, '22	25c
10.	Porch Swing	Aug., '22	25c
11.	Bench and Tilt Table	Sept., '22	25c
12.	Electric Washer	Oct., '22	25c
13.	Tea Wagon	Nov., '22	25c
14.	Christmas Toys	Dec., '22	25c
15.	Workshop Bench	Jan., '23	25c
16.	Inlaid Radio Cabinet	Feb., '23	25c
17.	Cedar Chest	Mar., '23	25c
18.	Phone Table and Stool	Mar., '23	25c
19.	Grandfather's Clock	Apr., '23	25c
20.	Flat-Top Desk	Apr., '23	25c
21.	Colonial Desk	Apr., '23	25c
22.	Cabinet and Desk	Apr., '23	25c
23.	Pergola Garage	May, '23	25c
24.	Gateleg Table	June, '23	25c
25.	Canoe Sailing Outfit	July, '23	25c
26.	Baby's Crib and Pen	Sept., '23	25c
27.	Kitchen-Cabinet Table	Oct., '23	25c
28.	Pullman Play Table	Nov., '23	25c
29.	Toy Tea Cart, etc.	Dec., '23	25c
30.	Tool Cabinet, etc.	Jan., '24	25c
31.	Sewing Cabinets	Feb., '24	25c
32.	Chinese Game Table	Mar., '24	25c
33.	Dining Alcove	Apr., '24	25c
34.	Garden Trellises	May, '24	25c
35.	Simple Radio Cabinet	Oct., '24	25c
36.	Rush-Bottom Chair	Nov., '24	25c
37.	Simplified Bookcase	Dec., '24	25c
38.	Sheraton Table	Jan., '25	25c
39.	Salem Chest	Feb., '25	25c
40.	Desk in Sheraton Style	Mar., '25	25c
41.	One-Tube Radio Set	May, '25	25c
42.	Three-Stage Amplifier	June, '25	25c
43.	Four-Tube Receiver	July, '25	25c

Name
(Please print)

Street.....

City and State.....



We Want Men with tough, wiry beards to challenge this

Let us send you free a 10-day tube of this unique shaving cream which softens the toughest beard in one minute!

MEN claim that Palmolive Shaving Cream will soften the toughest beard in one minute. No finger rubbing—hot water or cold, hard water or soft.

That's a broad statement, we'll agree.

You may doubt it. But, if true, you want that kind of shaving.

Let us give you a 10-day tube free. Find out for yourself. We believe we'll win you, no matter how firmly you are wedded to a rival preparation.

NEW Principles

Palmolive Shaving Cream is a new-comer in its field... yet, today the leader.

Millions of men have quit old ways and adopted this new shaving joy.

Probably 80% of its users were boosters for other makes of cream.

All were won over by the test we now offer you. "Don't buy—yet," we urge you. Put the proof burden on us.

* * *

60 years of soap study stand behind this creation... made by the makers of Palmolive Soap.

PALMOLIVE SHAVING CREAM

2979

10 SHAVES FREE and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B-1072, The Palmolive Company (Del. Corp.), 3702 Iron Street, Chicago, Ill.

Residents of Wisconsin should address the Palmolive Company (Wis. Corp.), Milwaukee, Wis.

.....



B.S.



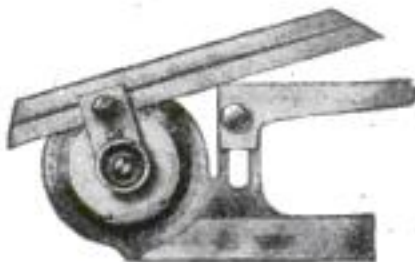
"Yes, Jim, that's why I got a better job"

"In the first place, remember, I have a kit of good tools. While the rest of you boys were shooting pool or at the movies, I was studying and building up my kit with Brown & Sharpe Tools getting ready for a bigger job. Some of the tools I didn't really need then, but I was certainly glad I had them later. When my chance came, I was ready,—that's why I got a better job."

Every mechanic finds that only with the best tools can he do his best work. With a good kit he is qualified to go higher. —He is equipped for the bigger job when it comes. Build up your kit with Brown & Sharpe Tools.

Send for Small Tool Catalog No. 29

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.



BROWN & SHARPE
TOOLS

"Standard of the Mechanical World"

The Home Workshop

How to Reline Auto Clutches

By Ray F. Kuns

Principal, Automotive Trades School,
Cincinnati, Ohio

EVEN with the best of care, clutches will wear out and need new linings or facings. A well designed clutch, cared for as suggested last month, will give many seasons of average service without relining. In many instances the clutch facings will not need to be replaced in the life of the car. In other cases the clutch facings will be damaged, seriously worn, or cut out.

The average car, excepting the Ford, has a so-called unit power-plant mounting of the clutch and transmission on the flywheel housing of the engine. The transmission case has a bell housing cast or bolted on it. This housing is machined to fit and be bolted to the flywheel housing. Consequently it is necessary to remove or "drop" the



Applying Clutch Facings

The rivet head is rested on a punch held in the vise, and a common rivet set or a ball-peen hammer is used to form the burr

transmission whenever repair work is to be undertaken on the clutch.

Individual cars may vary in this respect, however, and there are a number of cars having what is known as an amidship transmission mounting. As in the case of the unit power plant, it will be necessary to release and remove the transmission for any clutch work.

When preparing for the removal of the transmission, first place the car where it will be most convenient. Block the front wheels to prevent it rolling, since the brakes must be disconnected. Remove all brake connections, speedometer connections, and other attachments. There is always a universal attached to the rear of the transmission and from this universal a propeller shaft is run to the rear axle, where there may or may not be another universal, depending on whether or not the propeller shaft is of the type inclosed in a torque tube.

If the torque-tube construction is used, there is only one universal, and in order to drop the transmission it first is neces-

(Continued on page 90)

Kolster's Genius

Brings a New Thrill in Radio—



F. A. KOLSTER

For eight years he was head of the Radio Section of the United States Bureau of Standards.

He invented the Kolster Radio Compass for Navy and passenger ships.

The staff which he heads built most of the United States Navy Radio Stations.



Kolsters are presented in four models, one of which is pictured here; two are cabinets, two are for tables.

No Dials!

Super-tone is only one of many Kolster advancements.

This remarkable instrument has no dials!

Here is ultimate simplicity you've been expecting.

You just turn from one station to another on a register bearing the names of the different stations.

No "tricky" tuning with numerous dials. A child can operate it—perfectly every time.

A Kolster is to today's radio what today's automobile is to the old "horseless" carriage.

It is extremely powerful—selective and sensitive. All the old-time handicaps are eliminated. No "background" interference, no "howls."



A Surprise, Indeed

Hear this wonder instrument—either at the nearest Kolster dealer or in your own home.

Kolsters are housed in fine cabinets—masterpieces of design and beauty, adding charm and elegance to any room.

Once you hear the Kolster, you'll revise your standards of radio enjoyment—you'll be unhappy with a lesser instrument.

Discriminating people are saying with justifiable pride: "I own a Kolster."

KOLSTER RADIO

SPECIAL SAWS of SPECIAL STEEL



THERE is a Simonds Service Shop or Supply Dealer near you to furnish promptly Simonds quality Circular Saws, Band Saws, Files, and Planer Knives. Write for Mill Saw Catalog.

SIMONDS

Pronounced SI-MONDS

SAWS FILES KNIVES STEEL

SIMONDS SAW AND STEEL COMPANY, Fitchburg, Massachusetts

"The Saw Makers"

Branch Stores and Service Shops in Principal Cities

Established 1832

The Home Workshop

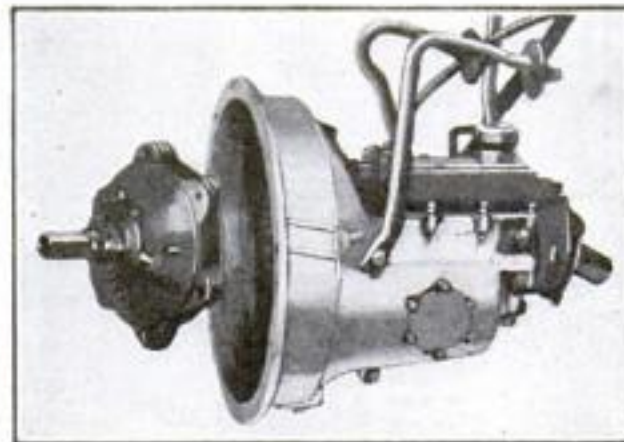
How to Reline Auto Clutches

(Continued from page 88)

sary to loosen all brake rods and then the spring clips holding the springs to the rear axle. When all the items that might prevent the removal of the rear axle are loose, the car frame is jacked up high enough to take all the weight off the rear springs and blocked securely in that position. Next, roll the rear axle back far enough to allow the splined joint of the universal to separate.

Covering the universal in this type of construction is a boot of leather or a steel cover of ball-and-socket type. This will have to be loosened. In other instances the front end of the propeller shaft is carried in a yoke and in that case the yoke pins need to be removed.

When the construction involves the use of an exposed propeller shaft there are always two universals. In this construction the rear axle need not be moved back, but the universals are removed from their flanges by removing the bolts,



Before the clutch can be taken out, the transmission must be removed from the car

and thus the propeller shaft and universals are removed together. Whatever the construction, the transmission cannot be dropped until the propeller shaft is removed.

After the attachments to the transmission are all free, the bell-housing type of transmission is removed by taking out all the small capscrews or bolts used to clamp it to the flywheel housing. Block up under it to prevent its dropping down when the screws are released. If there is a clamp supporting the clutch and brake pedal, it should be loosened.

When all parts are loose, slide the transmission back on its blocking. Note the small ballbearing on the forward end of the clutch shaft or in the flywheel center, which is used to carry the forward end of the clutch shaft and keep it in alignment. This is an important point in reassembling.

Slide the transmission out from under the car and remove the clutch and brake pedals and throw-out mechanism. This will allow the clutch to be removed as a unit in most cases.

Place the clutch under a press or use several blocks and a jack to compress the clutch springs. As a rule, a split washer will be found that may be removed and the clutch springs released and the plates separated. Note carefully the method of clutch

(Continued on page 92)

**EVEREADY HOUR
EVERY TUESDAY AT 9 P. M.**

Eastern Standard Time

For real radio enjoyment, tune in the "Eveready Group." Broadcast through stations—

WEAF	New York	WSAI	Cincinnati
WJAR	Providence	WWJ	Detroit
WEEI	Boston	WCCO	Minneapolis
WFI	Philadelphia	WOC	St. Paul
WGR	Buffalo		Davenport
WCAE	Pittsburgh		

ECONOMY

No ONE size or type of battery can be economical on every type of receiving set. That's why Eveready Radio Batteries are made in different sizes and types—so that every radio user can enjoy the economy that is to be had by fitting exactly the right Eveready Battery to his receiver. Even owners of sets with five, six, eight or more tubes, and power amplifiers, can realize Eveready economy to the full by using the new, radically different Eveready *Layerbilt* "B" Battery No. 486. There is an Eveready dealer nearby.

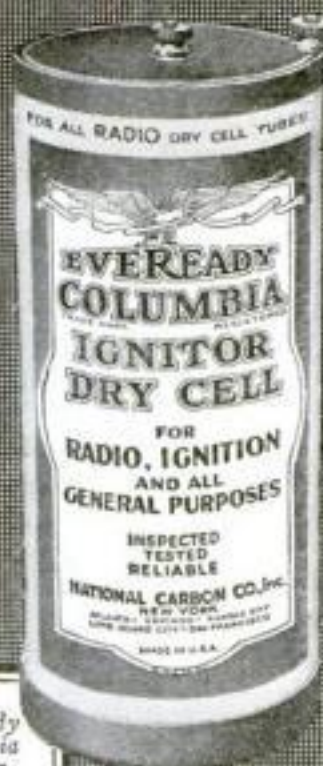
Manufactured and guaranteed by

NATIONAL CARBON COMPANY, Inc.
New York San Francisco

Canadian National Carbon Co., Limited, Toronto, Ontario

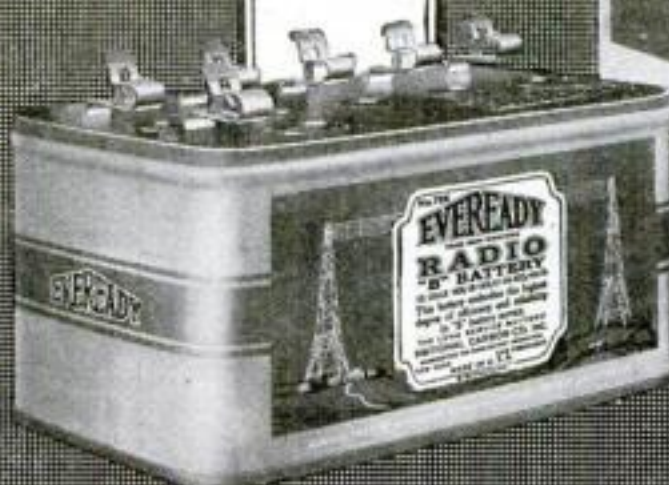
EVEREADY Radio Batteries

- they last longer



Eveready Columbia Ignitor "A" Battery, the proven dry cell for all radio dry cell tubes 1½ volts

No. 766
22½-volt
Large
Horizontal
Price
\$2.00



No. 486
45-volt
Layerbilt
Extra-
Large
Vertical
Price
\$5.50



Here's the Brace, men that you have dreamed of

OPEN up the jaws of that powerful chuck and feed it the biggest, fattest square shank you can find. Try an expansion bit if you have one. See how it slips through without a murmur. Put your hand around that finely knurled hardened steel chuck shell and run it down. How those jaws do grip!

Drop in a Morse Taper shank or a straight round shank, same result; perfect centering and that bulldog grip. Put the hexagon nose of the shell in a wrench or vise if you want a still more positive grip; you cannot hurt this little brute. That goes for the ratchet mechanism too.

Where is the ratchet mechanism? Safely encased in that neat

red enameled drop forging just above the chuck shell. Something entirely new—a patented feature—and this ratchet mechanism is as sure and as husky as it is different. Can you imagine yourself stripping a hardened tool steel dog $1\frac{1}{4}$ inches long which bites into teeth broached in a forged steel head? Just try to do it!

Need we add that the heavy steel sweep is nicely nickel plated, that the head and handle are polished rosewood, that the steel clad head is set on roller bearings? Only the best of fittings could have a place on a brace like this one. You can't find a better bit brace. Closely priced, too—\$6.20. Good hardware stores sell it.

GOODELL-PRATT COMPANY, GREENFIELD, MASS., U. S. A.

Toolsmiths

GOODELL-PRATT

1500 GOOD TOOLS

The Home Workshop

Unique Wooden Vise Is Aid in Keeping Saws Sharp

THE handsaw filing vise or clamp illustrated can be made of scrap lumber to be found in any home workshop and will prove both substantial and convenient. The jaws are 28 in. long, so that

CLAMP 28" LONG



How the saw filing vise is made

the entire saw can be clamped at one setting. When one side is sharpened, the saw and vise are turned bodily to file the other side. The frame is high enough to be placed on the floor and leaned against a bench in the best light. Placing one foot on the lower rail steadies the vise during filing.

Note that the wire is bound around the V-shape notches to prevent the wood from splitting.—W. L.

How to Reline Auto Clutches

(Continued from page 90)

assembly when dismantling.

In certain types of construction, notably the single plate, the clutch is assembled within the flywheel and will remain in the flywheel after the transmission has been removed. In this type it will be necessary to remove the plate bolted to the flywheel and thus get at the clutch facings, which as a rule are not fastened to any of the parts.

As a rule, in the multiple-plate or disk type, two friction disks are riveted to a steel plate that turns with the flywheel. When replacing these facings, which may be secured either from the supply houses or the dealer, care must be exercised to see that the rivets used are brass or copper and well countersunk so that there is no chance of their coming into contact with the steel faces of the driving disks. Most clutch facings come from the factory with properly countersunk or counterbored holes. If they have not been provided, however, care must be used in drilling them so as not to get them too deep. Any badly scored unlined clutch disks should be replaced.

When reassembling the clutch plates, use care to have them aligned so that they may be placed on the pins of the flywheel or in the grooves that are provided. It will be necessary to use the press or a jack to put pressure on the spring, or springs, in most cases.

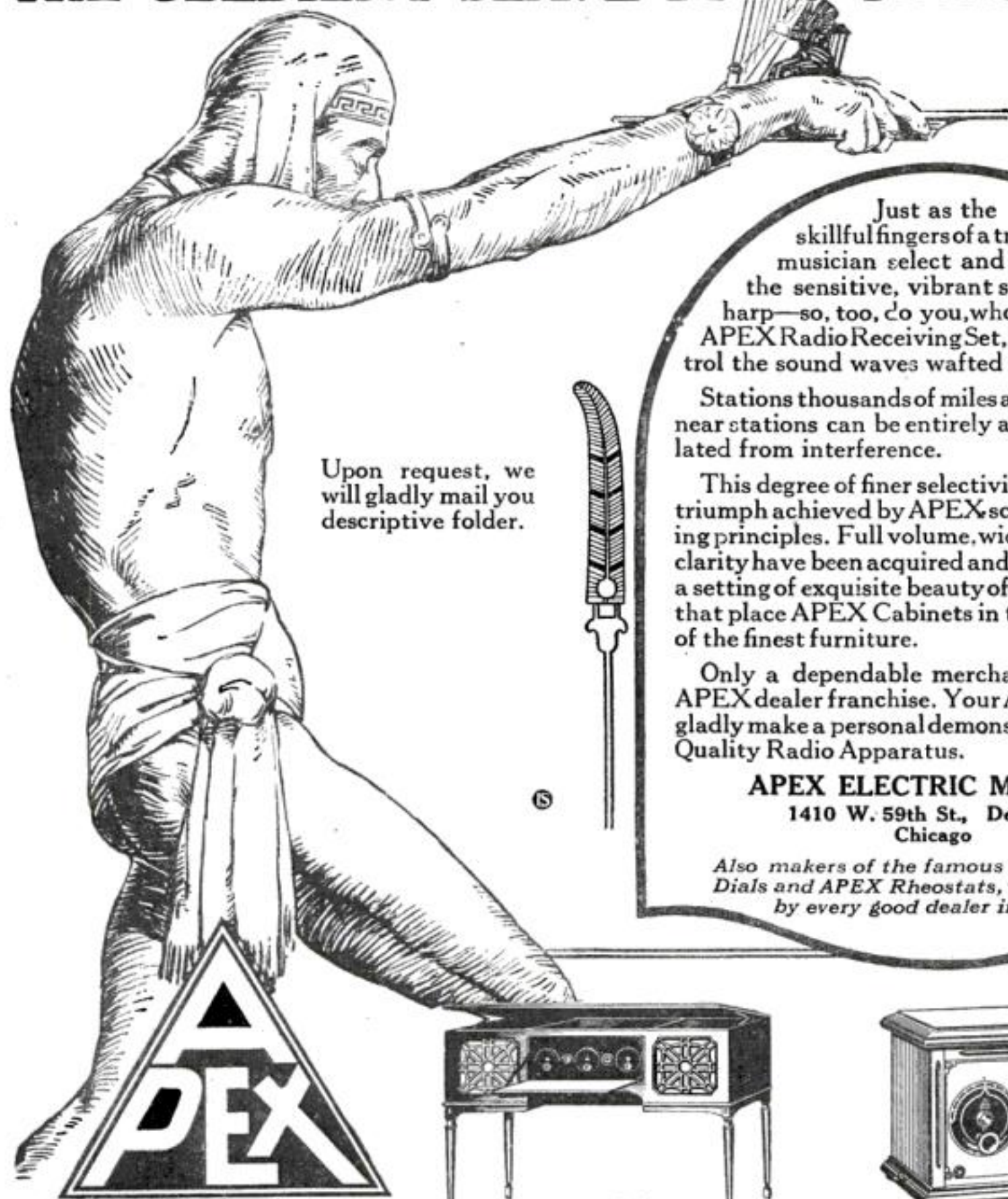
Make all connections that were removed preparatory to the work. It is a good plan to repack the universals with grease, clean and repack the pilot bearing, and properly lubricate all parts needing such attention.

When the job is finally assembled, it may be necessary to readjust the clutch pedal to the floorboard position.

Mr. Kuns' next article will be "What Makes My Car Jump Out of Second Speed?"

SELECTIVITY

THE OBEDIENT SLAVE TO YOUR DESIRES



Upon request, we will gladly mail you descriptive folder.

Just as the skillful fingers of a trained musician select and control the sensitive, vibrant strings of a harp—so, too, do you, who operate an APEX Radio Receiving Set, select and control the sound waves wafted through the air.

Stations thousands of miles away, or powerful near stations can be entirely and instantly isolated from interference.

This degree of finer selectivity is not the only triumph achieved by APEX scientific engineering principles. Full volume, wider range, greater clarity have been acquired and are enthroned in a setting of exquisite beauty of design and finish that place APEX Cabinets in the highest ranks of the finest furniture.

Only a dependable merchant is given the APEX dealer franchise. Your APEX dealer will gladly make a personal demonstration of APEX Quality Radio Apparatus.

APEX ELECTRIC MFG. CO.

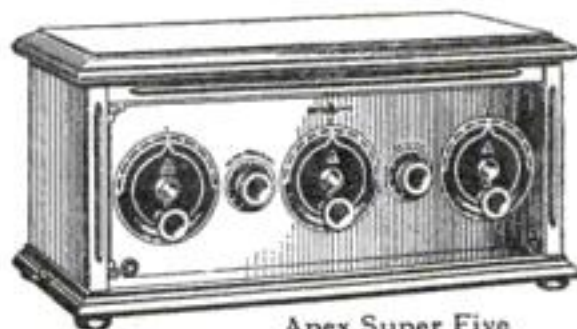
1410 W. 59th St., Dept. 1003
Chicago

Also makers of the famous APEX Vernier Dials and APEX Rheostats, which are sold by every good dealer in Radio.

APEX
Quality Radio Apparatus



Apex Baby
Grand Console
Price \$225



Apex Super Five
Price \$95
without accessories



Apex Console
Entertainer Price \$27.50



Apex
Entertainer
Price \$22.50



Apex Utility
Radio Table
Price \$75



Apex De Luxe
Price \$135

Prices West of Rockies slightly higher. Canadian prices approximately 40% higher.

When you see a "Hex"—think of BLACKHAWK!

Work Hounds

GOING after hidden nuts and bolts with a set of Blackhawk "Q.D.'s" is like putting bloodhounds on their trail. They like the work, and they never quit!

Have your dealer show you a Blackhawk "Q.D." set designed especially for your own make and model of car—it handles every nut you need ever worry about.

Downright quality is built into every Blackhawk "Q.D." set. Tough steel sockets, balanced handles built for the job, comfortable, hand-fitting grips, and a satiny black finish baked on to stay.

If your dealer is not stocked yet, write us direct.

BLACKHAWK MFG. COMPANY

(Formerly American Grinder Mfg. Co.)
Dept. L Milwaukee, Wis.

Also manufacturers of Blackhawk Water Pumps for Fords.



BLACKHAWK

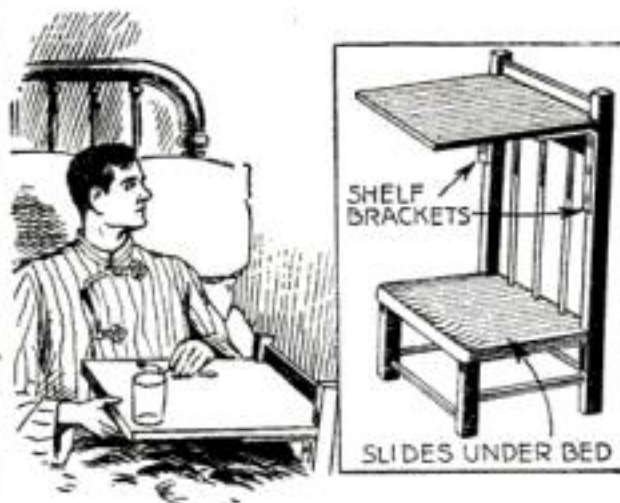
Welded Wrenches

The Home Workshop

Old Chair Used as Support for Bed Table

IN ILLNESS a bed table invariably adds to the patient's comfort and saves work on the part of the nurse, yet rarely is it considered worth while to purchase a special hospital table for home use.

A good substitute can be constructed by sawing off the legs of a discarded chair



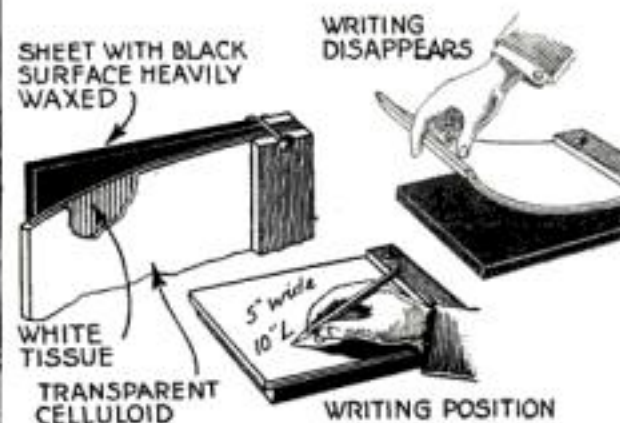
The table board is attached to the back of the chair with heavy shelf brackets

short enough so that the seat will slip under the edge of the bed. To the back of the chair fasten with shelf brackets a board the size of the seat in such a position that when the chair seat is slipped under the bed the table extends in front of the patient.—MINNIE BRITT RIGGLE, Bavaria, Kan.

Writing Is Erased Instantly from Everlasting Pad

HAVE you a place in your office or workshop for a scratch pad that is everlasting and indestructible? One may be made by coating a 1/16-in. thick sheet of black fiber or composition with paraffin. A sheet of aluminum will do nicely if it is given a heavy coat of dull black paint before being waxed.

A sheet of tough, yet very thin tissue paper and a sheet of thin celluloid, such as

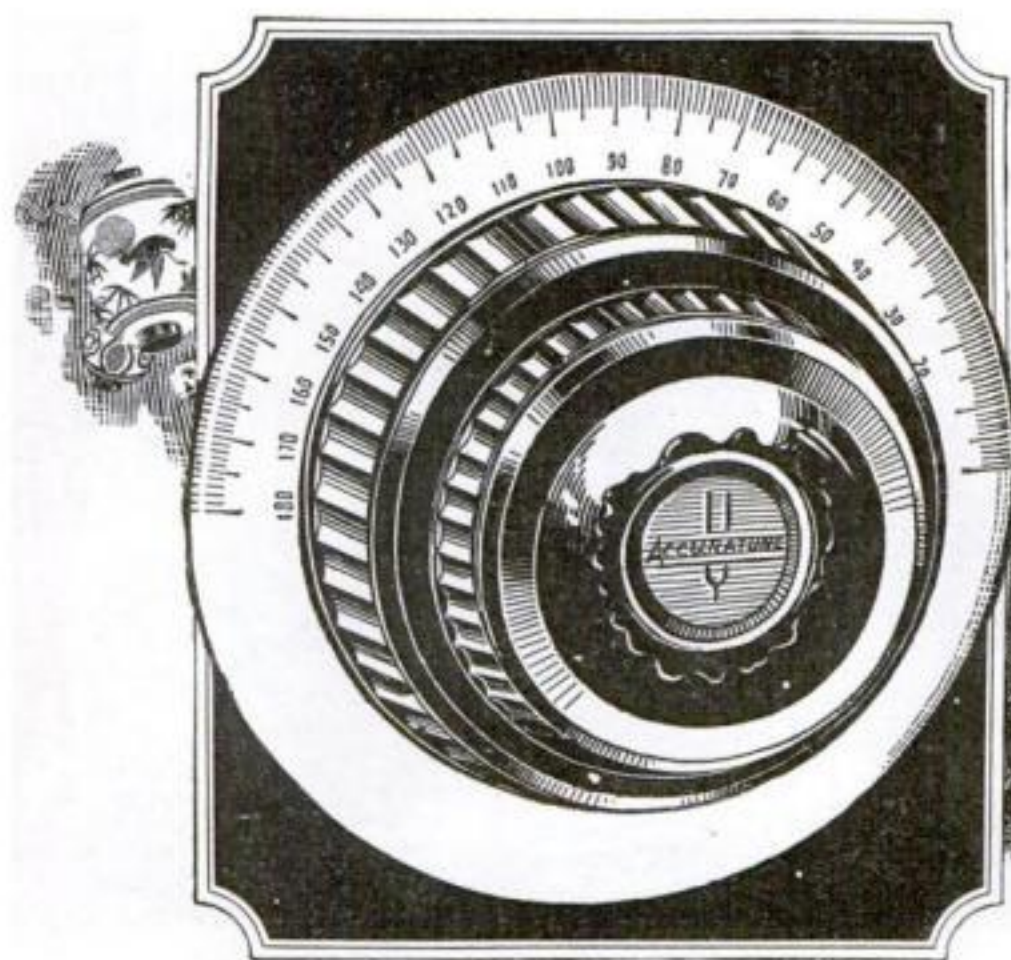


Notes made on the celluloid surface vanish when the celluloid and tissue paper are raised

is used in auto curtains, are cut the same width as the black base, but about 1/8 in. longer. The illustration clearly shows how the three sheets are assembled. The paper and celluloid are glued together along the edge farthest from the binding.

To write, use a pencil or any stylus, such as a nail or match. To erase the writing, merely lift the projecting edge of the celluloid sheet.—A. E. WILLIAMSON, Cleveland, Ohio.

AN ESSENTIAL ACCESSORY



Pat. Apr. 21, '25
Other U. S. & Fgn.
Patents Pending



When accuracy tuning counts—

ACCURATUNE

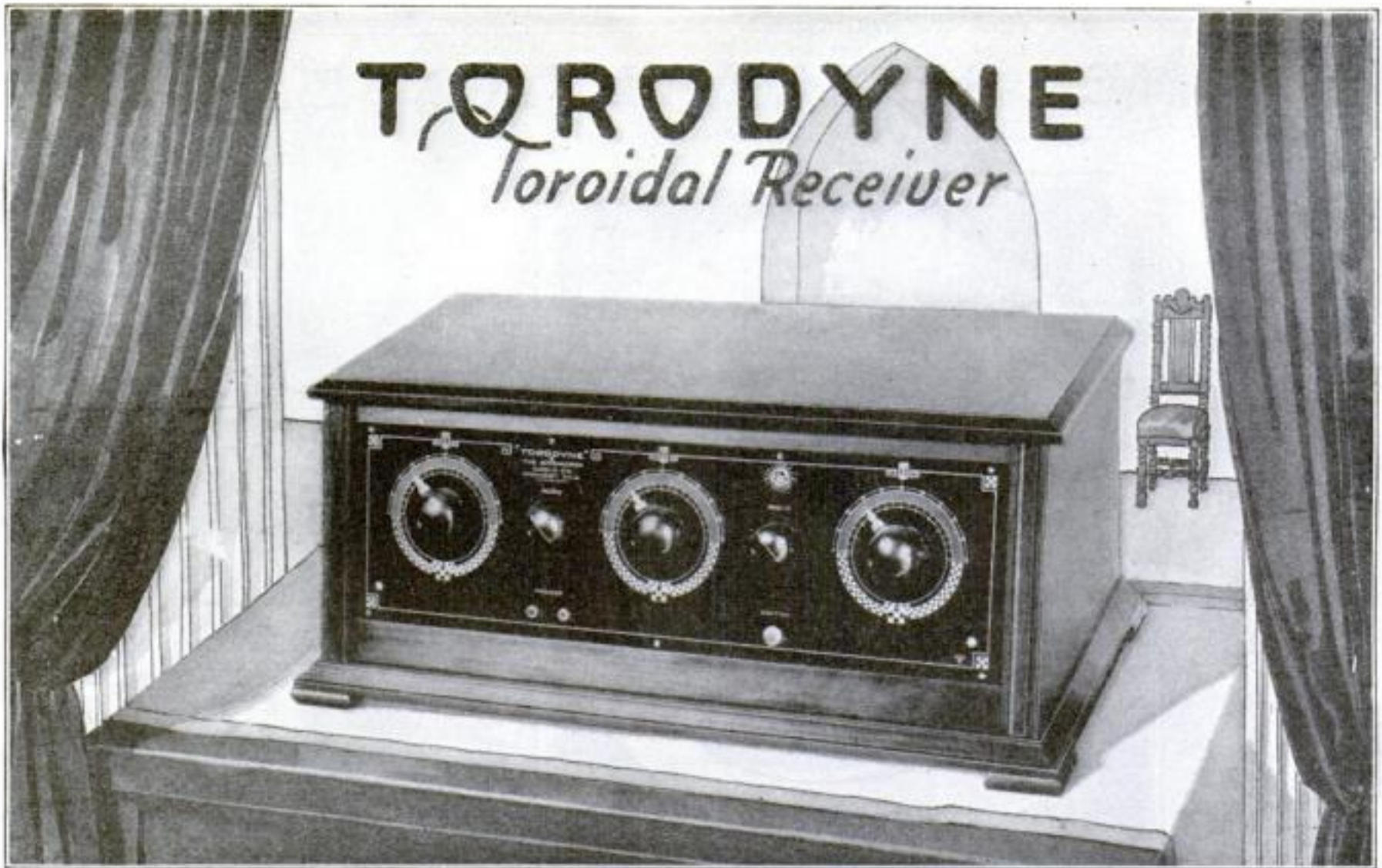


WHEN there's a particularly fine program at one of the stations within the scope of your set, then if ever do you yearn for precision, and that's exactly what you can be assured of if your set is equipped with the Accuratune.

Geared on an 80-to-1 ratio for coarse or infinitely fine tuning, the Accuratune performs with uncanny precision at all times. Moreover, it's easily substituted for ordinary dials without altering your set.

®

MYDAR RADIO COMPANY
15 CAMPBELL ST., NEWARK, N. J.



58 Stations in One Evening

Improved Radio Frequency Amplification

One of the leading features that place the TORODYNE ahead of the field is the use of Toroidal Transformers, which give it:

1. **GREATER SELECTIVITY** due to the fact that these coils do not pick up outside interference. Only the signal to which the set is tuned can be picked up as it must come through the antenna. Toroidal transformers will not pick up signals themselves.
2. **MORE VOLUME** without oscillations. These coils permit this by minimizing interstage coupling.
3. **DISTANCE.** The greater amplification increases the sensitivity bringing in distant stations with more volume. This naturally increases the range of the set.
4. **SUPERIOR TONE QUALITY** is secured through the elimination of distortion and foreign noises by preventing stray feed-backs.

IN ONE EVENING (two and one half hours actual time) 58 stations from Los Angeles to Boston, Calgary, Alberta to Ft. Worth and from Ottawa to Miami, Florida, were received with good volume and equal clarity of tone through a loud speaker. The time includes waiting for the announcement of call letters. Local Broadcasting was going on at the time without interfering.

This is but one of the records of the TORODYNE, the latest AINSWORTH Receiver. It is a five-tube, tuned radio frequency receiver with Torodial (doughnut type) transformers, which greatly increase the scope of radio frequency amplification. The TORODYNE will bear comparison favorably with any set and the difference can be quickly and easily distinguished.

An attractive, silver engraved sub panel leaves only the condensers and tube sockets visible on the inside of the cabinet. All terminals are mounted on this panel and plainly marked to insure correct connections. The entire construction is simple, compact and efficient. The TORODYNE is easy to tune and its accuracy permits constant logging.

The refined beauty of the TORODYNE harmonizes with any period furniture. The black, sloping panel is silver engraved by a patented process and mounted in an Adam brown mahogany cabinet. Pointers on Bakelite knobs over scales engraved on the panel.

In every way the TORODYNE is a set you will be proud to display to your friends—beauty, exceptional performance and the latest improvements in radio.

The TORODYNE will give genuine satisfaction. Ask your dealer for a demonstration and judge for yourself. (If your dealer is not showing the TORODYNE, write us.)

Price \$100.⁰⁰

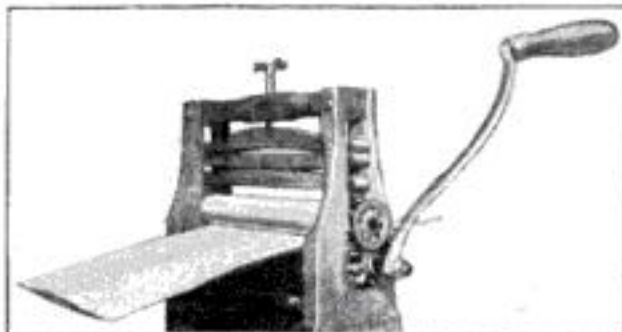
The Ainsworth Radio Company

Third & Main Streets

Cincinnati, Ohio

The Home Workshop

Ferrotyped Photos Squeegeed in Old Clothes-Wringer



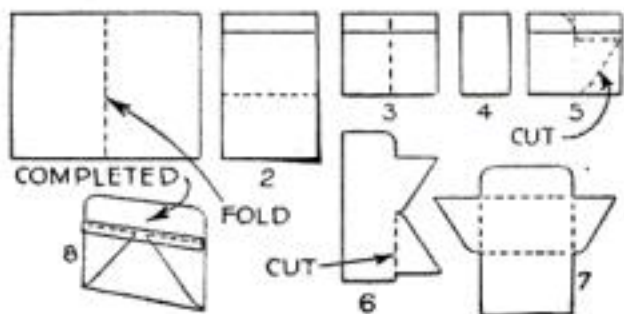
THE amateur photographer, who makes very glossy prints by ferrotyping on a Japan tinned metal plate, often finds the rolling of the prints by hand tiresome. Where many prints are to be made, an old clothes-wringer is useful.

The best results are obtained by placing the wet prints face down on the plate and then putting one blotter over the prints and another underneath the plate. Only moderate pressure is necessary.

Unique Method for Cutting and Folding Neat Envelopes

CHEAP and easily obtained as are envelopes, it probably has happened again and again that you have not had an envelope at hand of exactly the right size or quality to suit some special purpose. This predicament will never cause any delay, however, if you know the trick of making a square-cornered envelope with nothing but paper and scissors.

Any paper can be used. Good quality letter or sample paper may be used for small envelopes, and drawing, manila, or



Eight steps in making large or small envelopes without the aid of ruler or square

heavy wrapping paper for large ones.

The sheet, say an 8½ by 11 in. letter-head, is first folded from left to right on the vertical center line. Next, it is folded from the bottom up (2) to bring the bottom edge within 1 in. of the top edge. Next fold in the center (3) to get a crease for cutting (4). Open out and cut the outline of the flaps (5), as shown by the heavy dotted lines. This is easily done without drawing guide lines. Open the sheet at the lower fold (6) and cut off the superfluous flaps to give the completed form (7). The envelope then is folded (8). The small retaining flap, when folded over, holds the envelope in shape while the letter is being inserted.

Paste is applied to the top flap when the envelope is used, or it may be applied and left to dry, as on commercial envelopes. Pasting down the top flap seals the entire envelope, although the side flaps also can be pasted if desired.—J. A. FITZPATRICK, Milesburg, Pa.

TRADE **YALE** MARK

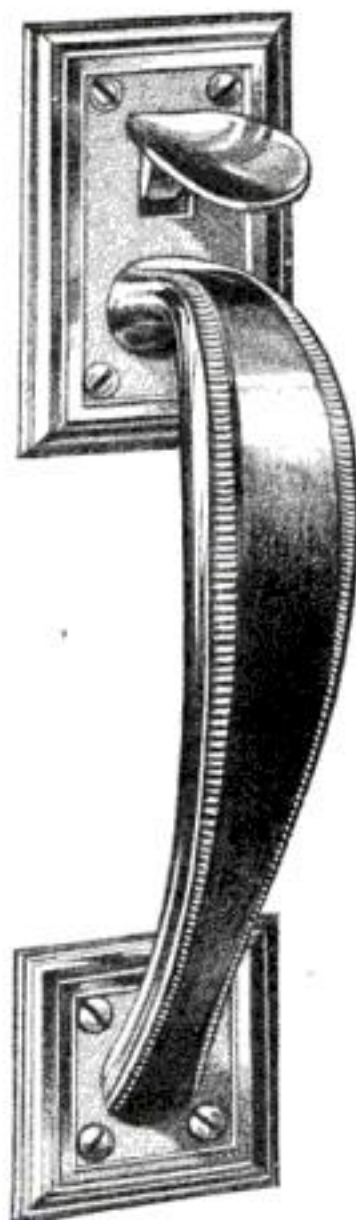


Be SURE of your Hardware

ARE you one of the home buyers who know good hardware? Cheap hardware of plated steel comes out of its box clean and fresh. It looks good—for awhile—but get beneath the surface. Cheap hardware never lasts. The tarnished metal; the discoloration on the door pointing a telltale streak of rust at the hardware that caused it; the faulty working of the lock—all these, in a few weeks or months, tell you the story of cheap hardware—but then it's too late.

How much better it is to be sure. Look for the mark YALE. Tell your architect or builder that you want Yale Hardware in solid brass or bronze. Make sure the name YALE is on it. That is the mark of good hardware worthy of your home.

For sale by dealers everywhere.



The Yale & Towne Mfg. Co.

Stamford, Conn., U. S. A.

Canadian Branch at St. Catharines, Ont.

YALE

YALE MADE IS YALE MARKED



A Striking and Conclusive Test of the Steel in NICHOLSON Files!

Twenty-five years ago, an Osage Indian in Oklahoma made this razor from a NICHOLSON File of regular stock, the braves using it to shave around the scalp lock.

Now, from the South, a man sends us samples of superior quality razors he is making from NICHOLSON Files.

Incidents like these, twenty-five years apart, prove conclusively that year in, year out, only the best file steel is used in NICHOLSON Files.

For shop or home, there is a NICHOLSON File for every need. Your hardware dealer will gladly help you select those best suited for your purposes.



NICHOLSON FILE CO.

PROVIDENCE, R. I., U.S.A.

NICHOLSON FILES

~a File for Every Purpose

The Home Workshop

Platform across Large Tub Supports Baby's Bath



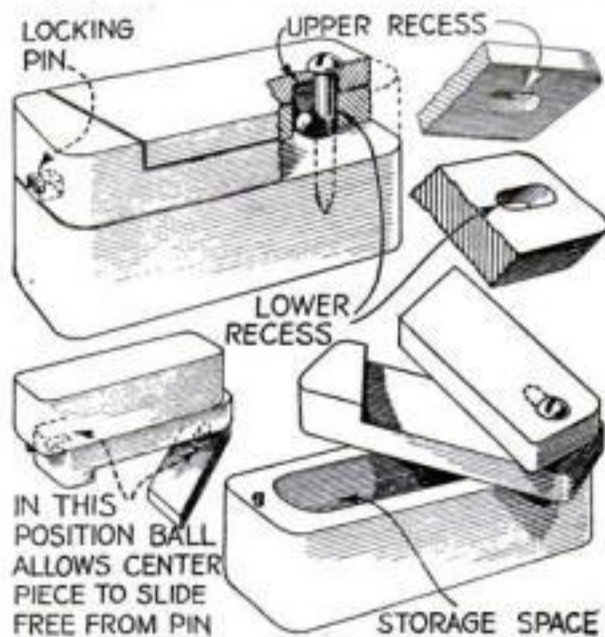
MOTHERS who bend over the bathtub in giving baby a bath can make it easier for themselves by having a platform or bench constructed to go across the top of the tub, as illustrated.

The wooden slats are fastened together by a strip of wood on the under side at each end. Baby's tub is placed upon the platform, which can be slid to one end of the tub or removed entirely when not in use.—J. G. P.

Ball and Screw Provide Novel Lock for Curious Puzzle

YOU can make the curious little toy bank, jewelry box, and puzzle illustrated below with nothing but a piece of waste wood, a wood screw, and a bearing ball.

The size of the original, which was made by A. J. Drake, of Sturgis, Mich., is $1 \frac{1}{16}$ by $1 \frac{11}{16}$ by $3 \frac{3}{8}$ in. over all. The lower block, containing the storage space, is 1 in. deep. The wood screw is $1 \frac{3}{8}$ in. No. 6,



This puzzling little box can be opened only when turned to get the ball out of the way

and the steel ball is $\frac{3}{16}$ in. in diameter. Of course, the puzzle may be made larger or smaller.

To open it is more of a trick than appears and even when some one accidentally stumbles upon the combination, he usually cannot succeed in closing the lid again.

Hold the box in the position shown in the upper drawing and turn it away from you until it is upside down. Then pull out what is now the lowest piece until it is at right angles to the rest of the box. It then is possible for you to slide the middle section to the right sufficiently to allow it to clear the locking pin, as indicated in the small drawing at the left.—J. B. Roswick, Sturgis, Mich.

KODEL RADIO

The Emblem of  Worth in Radio

Setting a New Radio Standard



LOGODYNE
"BIG FIVE"

\$90⁰⁰

Five tubes, self-balanced tuned radio frequency; sloping panel gold engraved; beautiful, massive, Adam brown mahogany cabinet; compartment for batteries; stations already logged for easy tuning.

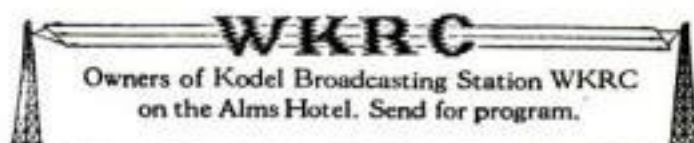
Radio for years to come will not offer a better receiver than the LOGODYNE Big Five. Combining the utmost in performance with striking beauty of cabinet design, the LOGODYNE Big Five represents a triumph in radio engineering and artistry of manufacture.

No receiver could better express or exemplify the high standard to which the entire KODEL RADIO line is built—the best that radio offers.

Free

Send for the new edition of our free booklet "The Secret of Distance and Volume in Radio". Gives helpful interesting information on radio operation.

THE KODEL RADIO CORPORATION
500 East Pearl Street Cincinnati, Ohio



LOGODYNE "Big Five" Console Model—the Aristocrat of Radio; built-in loud speaker; compartment for batteries and charger a masterpiece in furniture design. **\$275**



LOGODYNE "Standard Five" Console Model—beautiful brown mahogany; built-in loud speaker; compartment for A and B batteries and charger. **\$165**



LOGODYNE "Standard Five"—five tubes self-balanced tuned radio frequency; gold engraved panel and sub-panel; battery compartment; handsome brown mahogany cabinet. **\$70**



KODEL "Gold Star" Models—
Three Tube "Gold Star" Model. **\$30**
Two Tube "Gold Star" Model. **\$20**
One Tube "Gold Star" Model. **\$12**
"Gold Star" Crystal Set. **\$ 6**

Pride In Accomplishment

THE meter showed an increase! "Something wrong," said the Professor of a leading Institute of Technology. He was comparing current flow in Condensers. An expensive laboratory standard was placed in the circuit and readings taken, then a B-T Condenser substituted. **And the meter showed an increase.** A second B-T was tried and still the meter showed an increase.

"Laboratory Standard needs cleaning," said the Professor, "Try another." Same result. "Clean them up, check carefully"—and still a greater current flow,—showing conclusively that **B-T stock condensers had lower resistances than laboratory standards.**

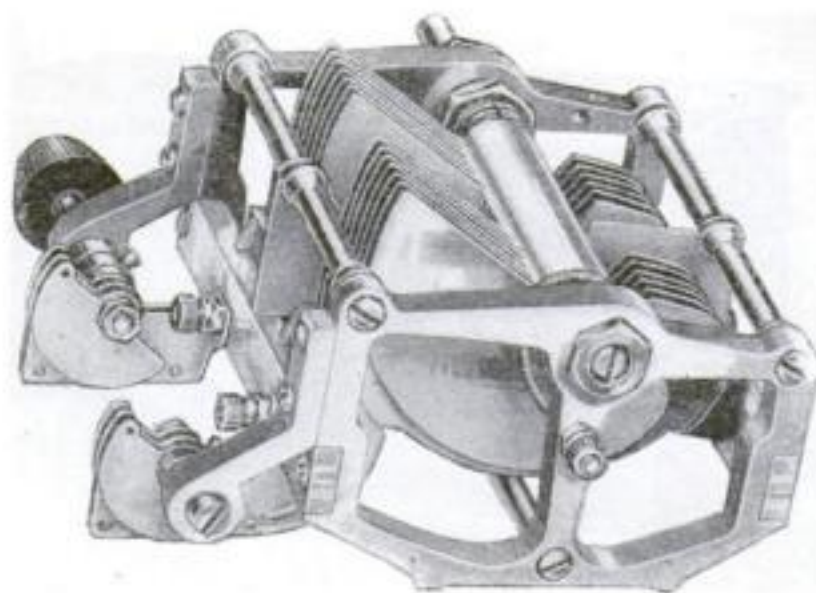
We hold the Professor's signed statement—and we feel that such performance justifies a pardonable pride in our design and workmanship. That's why we have printed on every condenser carton "If you don't find it Better Send It Back."

Satisfaction to the User

has always been our aim. You will not be disappointed in the B-T TANDEM if used in efficient circuits. Changing from two dials to one requires more than mere mechanical arrangement. Our Reputation is your best assurance that the design balance, and operation of the vitally important "trimmers" answer the purposes intended and the necessities required. LD-13 (.00025 units) \$9.00 LD-17 (.00035 units) \$9.50

B-T Straight Line Frequency Condensers

have the same qualities as those mentioned above, but with differently shaped plates. Some prefer them. The .00035 is used with B-T Torostyle Inductances. Note that the price is \$5.75



Another Forward Stride

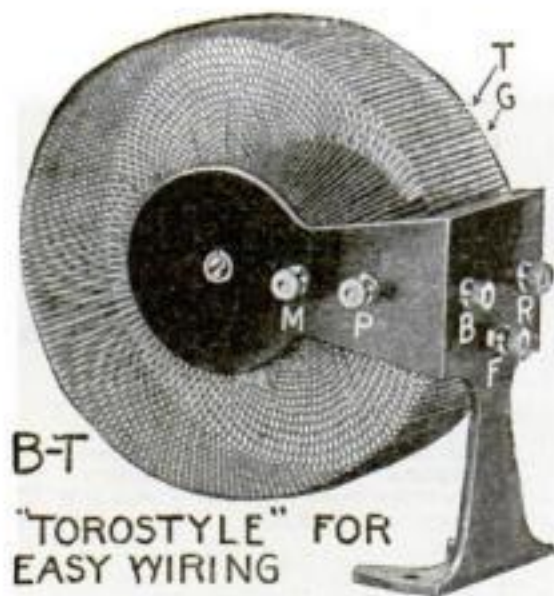
Six tube sets are not uncommon—but with three stages in the **audio end.** We claim the sixth tube belongs as a third stage of **Radio frequency**,—and the accomplishment of its control with only two tuning dials we believe will prove our greatest success.

The B-T "Counterphase" Circuit is covered by U. S. patents. It employs Torostyle Transformers, and can be built in five or six tube sets. The latter brings distant stations with ample volume on a short indoor antenna. The exclusive B-T method of oscillation control permits operation at the point of maximum efficiency at **all** broadcasting wave lengths.

Years of Effort Yield Success

The B-T record—the first three circuit tuner, first air core transformer, and first 3-circuit transformer, displays a basic knowledge of correct inductance design. Experience has broadened that knowledge—continued research has deepened it—but it was all needed in avoiding the pitfalls and developing the possibilities of the toroid coil. Here is another product when the wise buyer will pin his faith on the reputation of the manufacturer behind it.

The B-T Torostyle is arranged for easy wiring—and is built in three styles: TA Antenna Coupler; TC, R. F. Stages, and T-4 for 4-tube sets. Price \$4.00 each.



B-T

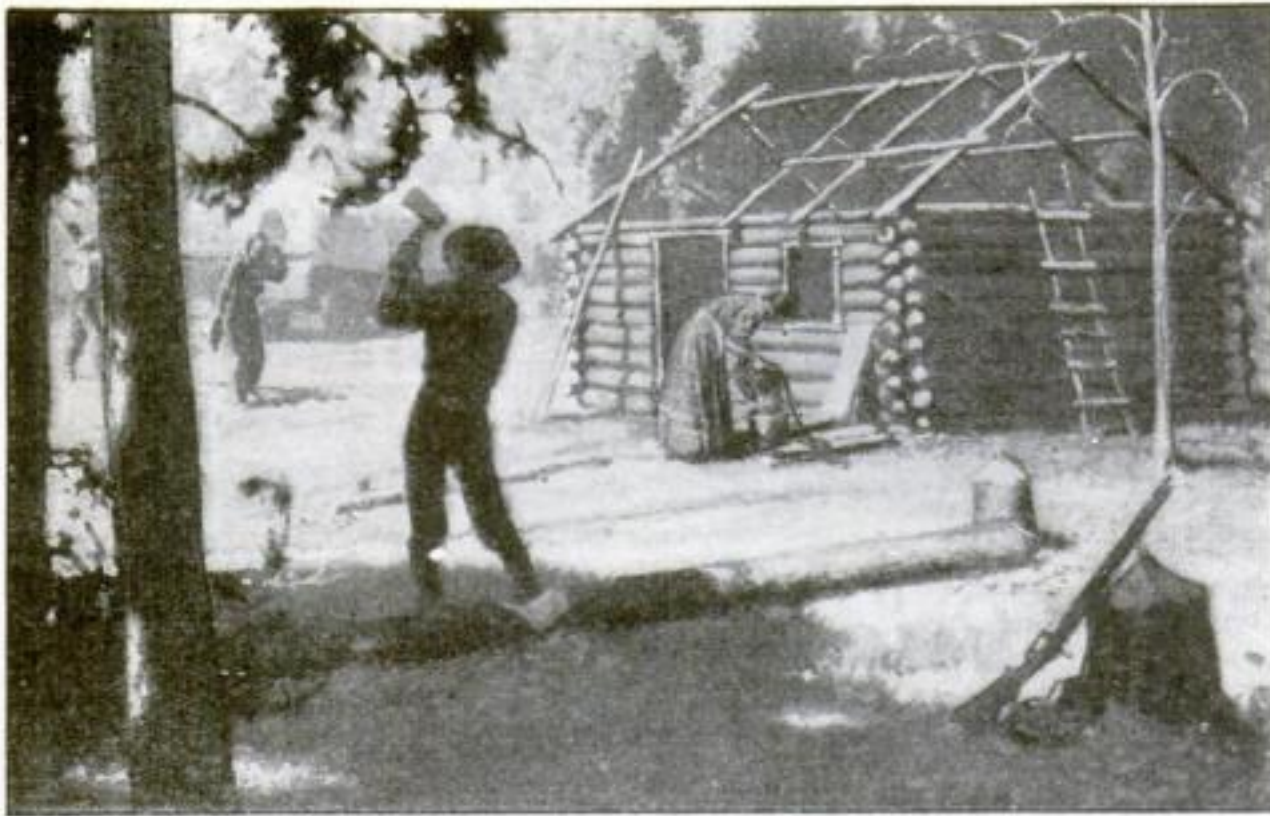
"TOROSTYLE" FOR
EASY WIRING

Send more information on the full B-T Line, including Tuning Controls, Universal Sockets, the new idea in Audio Transformers, etc. Send 48-page Booklet "BETTER TUNING," 10c enclosed.

Send "BETTER TUNING" one year, 50c enclosed.

I am interested only in a factory-built set. Send information.

Bremer-Tully Mfg. Co. [®]
532 S. Canal St. Chicago, Ill.



Building for America's growth

The early builders of America made their houses of rough hewn logs or of stone or adobe lifted from the earth. Settlements grew to towns, towns to cities. Small stores and shops were built, and these in turn were torn down to make room for bigger ones. Roads, bridges and railways were constructed. Factories and skyscrapers were erected. And so, swiftly, the America of today appeared, still growing.

In the midst of the development came the telephone. No one can tell how much of the marvelous later growth is due to it—how much it has helped the cities, farms and industries to build. We do know that the telephone became a part of the whole of American life and that it not only grew with the country, but contributed to the country's growth.

Communication by telephone has now become so important that every American activity not only places dependence upon the telephone service of today, but demands even greater service for the growth of tomorrow.



AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

One Policy, One System, Universal Service

JUST OUT!

KEY TO ELECTRICITY

Audels Handy Book of Practical Electricity, 1 Vol. \$4

Complete in One Pocket Size, Flexible, Bright Red Leather Volume

A simplified ready reference, giving complete instruction and inside information. Handy to use. Easy to understand. For Engineers, Professional Electricians, Students. A reliable authority and a handy helper for every electrical worker.

INFORMATION

The 1040 pages and 2600 diagrams give accurate, up-to-date and complete information on—Rules and Laws RADIO, Storage Batteries, WIRING DIAGRAMS, Power and House Wiring, Automatic Phones, Auto Ignition, Motor Troubles, ARMATURE WINDING, Cable Splicing, Elevators and Cranes, Sign Flashers, Transformers, Practical Management, Modern Applications—READY REFERENCE on every electrical subject. Pocket Size, handsomely bound in flexible Red LEATHER. Easy Terms. Shipped for Free Examination. No obligation to buy unless satisfied.

COMPLETE COURSE FOR HOME STUDY

Learn more and you will earn more. Know the facts in Electricity. This coupon is your opportunity. Use it now!

**FREE
EXAMINATION
COUPON**

The Audel Co., 65 W. 23 St., New York
Please send me Audel's Handy Book of Practical Electricity for free examination. If satisfactory, I will send you \$1 in 7 days, then \$1 monthly until \$4 is paid.

Name.....
Address.....
Occupation.....
Employed by..... 10T34



"Audel's Handy Book of Electricity is all that you claim for it and then some. Very well pleased with it. Find it a great help in many things."—C.F. Woerner, Jr., Lakewood, N.J.

The Home Workshop

How to Construct a "Two-Tone" Radio Cabinet

By R. A. Kelly

MANY radio fans, after taking the utmost pains in assembling a fine receiver, are content to place it in a cheap, commercial cabinet with a thin, easily marred and relatively unattractive finish. Certainly any one who can assemble a complicated radio set can build himself a suitable cabinet, for little wood-working skill is required and the application of a really fine finish is merely a matter of knowing what to do and having plenty of patience.

The cabinet illustrated holds a set operated by dry cells, which go into the small side compartments. In this case the panel is 7 by 14 in., but the cabinet can be made to suit a panel of any size.

One of the most satisfactory substitutes for genuine mahogany or walnut is whitewood, because it is easy to work and



This cabinet, which takes a 7 by 14 in. panel, has two compartments for dry batteries

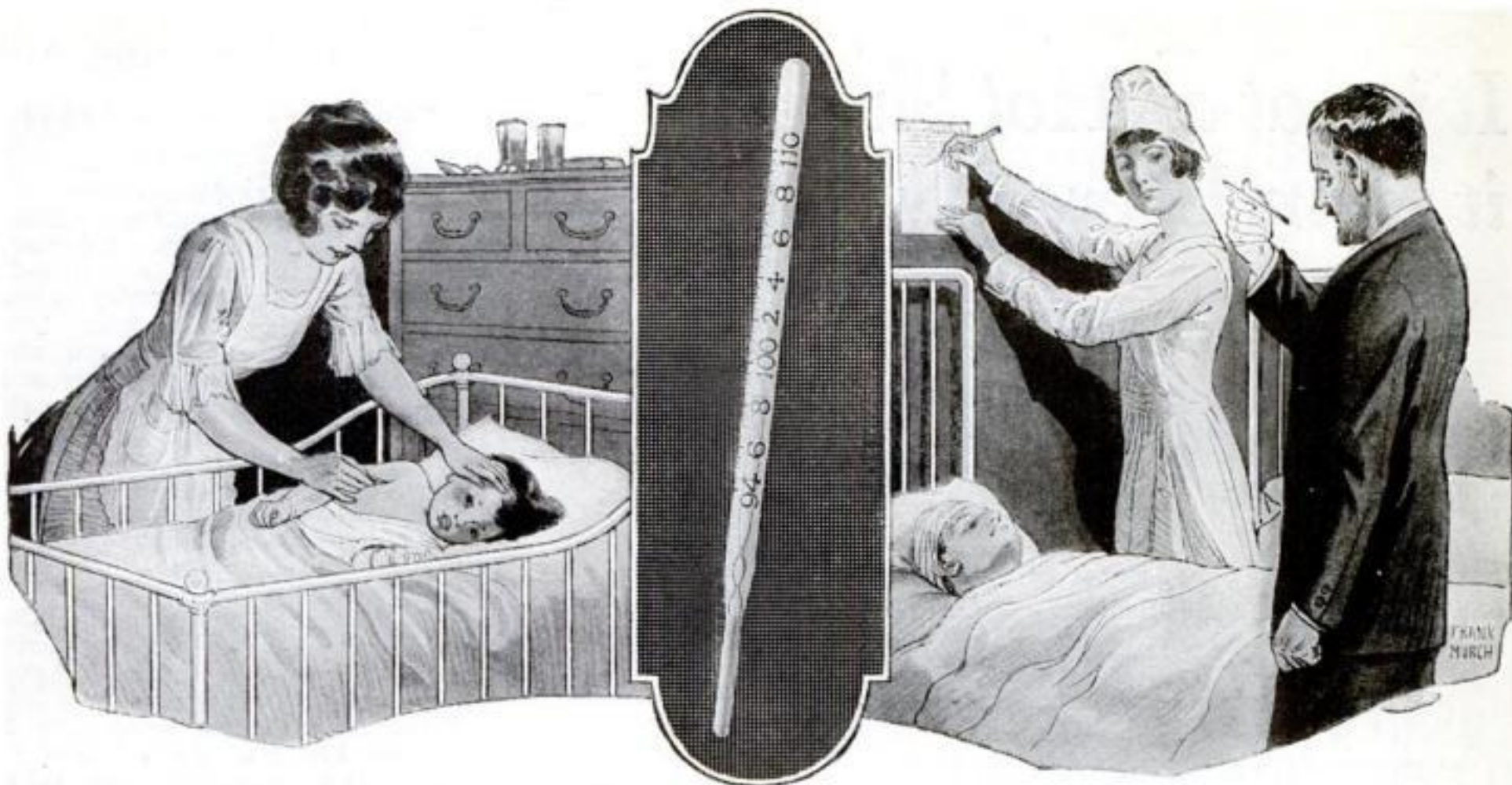
takes a mahogany dye or wood stain very well. In purchasing the wood, be sure to pick out pieces that are not warped and have a good looking grain. You will need a $\frac{1}{2}$ by 12 in. board 8 ft. long and a $\frac{3}{4}$ by 12 in. board 3 ft. long, as well as 8 ft. of any suitable $\frac{3}{4}$ by $\frac{1}{8}$ in. stock molding to go around the base.

After the base has been cut to the finished size, which in this case is $\frac{3}{4}$ by 10 by 27 in., nail the molding neatly around it, mitering the corners. Then cut the other pieces as shown, being sure that the ends and the partitions have the grain running from top to bottom, so that the front edge of each piece will look well when finished.

Keep the back, ends, and front $\frac{1}{4}$ in. in from the edges of the baseboard. Fasten the back, ends, and partitions to the base with $1\frac{1}{4}$ -in. flathead wood screws. All other joints may be held with brads, the heads being punched well into the wood.

A piece $\frac{1}{2}$ by 1 in. by 2 ft. 2 $\frac{1}{2}$ in. is nailed across the front at the top to act as a brace. Small strips are placed so as to form stops for the panel and the two doors of the battery compartments. If the doors are made a fairly tight fit they will stay in place by themselves. If desired, however, common ball-and-socket friction catches may be used to hold the doors in place, these being easier to apply and more convenient in use than hinges

(Continued on page 104)



In Hospitals and Homes Tycos THERMOMETERS Protect the Health of the Nation

IN ALL hospitals where the beds filled with patients stretch down the wards in long, orderly rows, the thermometer is the compass used by the doctors to help guide their patients through the dangerous channels of sickness.

Nowhere do *Tycos* Thermometers play a more vital role than in hospitals where the carefully charted temperature of the patient is the first thing the doctor looks at when making his rounds. The easily read figures, the proportion of tube to bulb, the perfection of the magnifying lens and the ease—consistent with safety—with which the column of mercury may be shaken down after use make the *Tycos* Fever Thermometers popular with doctors and nurses.

Important as they are in hospitals, *Tycos* Fever Thermometers are equally important in the home to guard the health of the children and the older members of the family.

To Manufacturers

The same accuracy that makes *Tycos* Fever Thermometers the protectors of the health of the nation is available to manufacturers of all products that go through processes demanding accuracy of temperature control. In the *Tycos* line of 8000 different kinds of Heat Indicating, Recording and Controlling Instruments—the Sixth Sense of Industry—there are instruments that will help you produce absolutely uniform products. Whether you bake bread by the mile, make candy by the ton, can fruits or vegetables by the carload, or use heat in your manufacturing processes for any purpose, it will pay you to learn how other manufacturers are using the Sixth Sense of Industry to get the uniform results essential to manufacturing on a large scale.

Informative literature on any type of instrument will be sent you on request. Or our engineer will consult with you on the application of *Tycos* to your particular manufacturing problem.

SHORT & MASON, LTD.
Manufacturing Distributors
in Great Britain.

Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. • • • U. S. A.
Canadian Plant: *Tycos* BUILDING, TORONTO



Tycos— for the Home

Tycos Office Thermometers
An aid in promoting
human efficiency

Tycos Bath Thermometers
To enable you to get
the most good from
your bath.

Taylor Home Set
Bake Oven Thermom-
eter, Candy Thermom-
eter, Sugar Meter. The
secret of accurate re-
sults in cooking.

Tycos Wall Thermometers
To help you maintain
a temperature in your
house conducive to
good health.

Taylor Quality Compasses
To show you the right
way in unfamiliar
country.

Tycos Fever Thermometers
A necessity in every
home.

Tycos Stormoguide
Forecasts the weather
twenty-four hours
ahead with depend-
able accuracy.

Tycos Hygrometer
To enable you to keep
the humidity of the
atmosphere in your
home correct at all
times.

Your dealer will show them to you. Ask us,
on a postal, for booklets on any of the above.

Tycos— for the Medical Profession



Tycos Sphygmomanometer, Pocket and Office
types

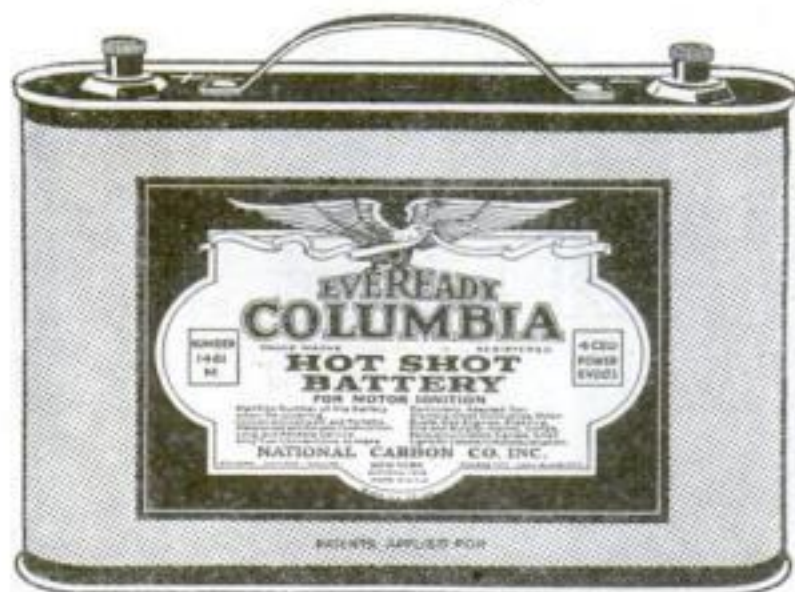
Tycos Urinalysis Glassware.

Tycos Fever Thermometers.
Bulletins on request.

THE SIXTH SENSE OF INDUSTRY
Tycos Temperature Instruments
INDICATING • RECORDING • CONTROLLING



It is not a "Hot Shot" unless it is an Eveready Columbia



WHEN you ask for a "Hot Shot" Dry Battery, it will pay you to make sure you get one. Any group of dry cells connected in a package is not a Hot Shot. "Hot Shot" is a trade-marked name and means only Eveready Columbia. Hot Shots come in three sizes, containing 4, 5 or 6 cells, giving 6, 7½ or 9 volts. In a neat, durable, water-proof steel case

with convenient carrying handle. Every one is labeled "Eveready Columbia Hot Shot." Experienced battery men prefer these batteries because of their superior service—they last longer. It will pay every dry battery user who needs 6, 7½ or 9 volts to ask for Hot Shots and to make sure of getting them. There is an Eveready Columbia dealer nearby.

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, INC.
New York San Francisco

Canadian National Carbon Co., Limited, Toronto, Ontario

gas engine ignition
motor boat ignition
tractor ignition
starting Fords
lighting tents and
outbuildings

running toys
telephone and
telegraph
doorbells
buzzers
heat regulators

ringing burglar alarms
protecting bank vaults
electric clocks
calling Pullman
porters
firing blasts

EVEREADY COLUMBIA Dry Batteries

-they last longer

The Home Workshop

A "Two-Tone" Radio Cabinet

(Continued from page 102)

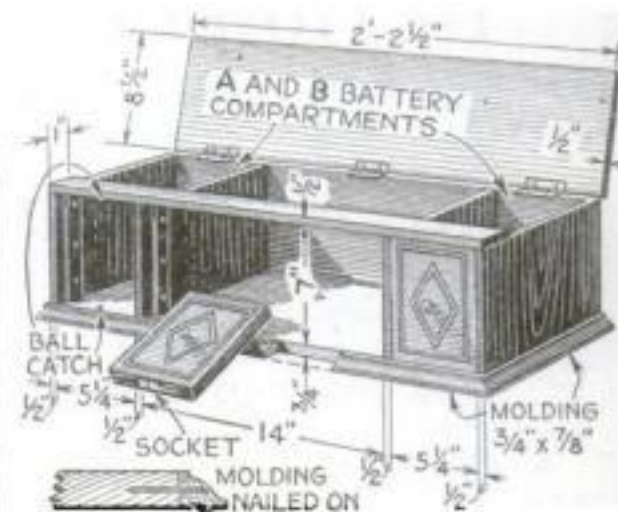
for this purpose. Six ordinary dry cells will fit in one compartment and two small size 45-volt B batteries will go into the other.

When the construction is completed, sandpaper the cabinet thoroughly, finishing off with No. ½ or finer paper.

For finishing the cabinet you will need ½ pt. each of dark mahogany and light oak wood dye or stain, although only a small portion actually will be used; 1 pt. white shellac, 1 pt. denatured alcohol, a little putty, a few sheets of No. 00 or finer sandpaper, a little powdered pumice-stone, ½ pt. lemon oil, one soft bristle brush, and one small cheap artist's brush.

Dust the cabinet well and apply the mahogany stain to all surfaces except the doors. Do one section at a time and work quickly to avoid laps.

While the cabinet is drying, draw a ½-in.-wide border around each door ¼ in. from the edge, using pencil and ruler.



Details of the cabinet, the dimensions of which may be modified to suit any panel

Then draw the diamond-shaped design in the center, keeping the points about 1 in. away from the edges. With pocket-knife and ruler cut quite deeply on the pencil lines and then enlarge these cuts with a sharp pointed file or other tool. With the smaller brush, color the background of the doors as shown, using the mahogany dye. Be careful not to let the color run into the border or the diamond. The indentations previously made are to aid in keeping the color from spreading.

Clean the brush and apply the light oak stain to the remaining areas, which are to be very light in color. It will do almost as well to stain these with very light mahogany dye. This can be made by greatly diluting the dark dye with either turpentine or alcohol, as specified by the manufacturer. In that case the cost of the light oak stain can be saved. The idea is to have a decided contrast between the design and the background on the doors, giving the two-tone effect now so popular. It is well first to practise applying these two tones on a scrap piece of wood.

Color a little putty with the mahogany stain until it matches the cabinet and fill the nail holes and any open joints.

(Continued on page 106)

AGENTS NEW SPARK PLUG

Visible Flash
Just Out—Amazing Invention—**Beacon Light Spark Plugs.** You see the flash of each explosion in the cylinders. Tells which are firing right. Greatest improvement in spark plugs since gas engines were invented. Wonderful gas savers. Agents making money.

\$90 A WEEK
Easy to make with new sure-fire plans. Sells on sight to every auto owner. Phillips, Ont., writes "Sold 2 dozen today, 3 dozen yesterday. Rush 10 dozen." Write for special **Free Demonstrator Offer** and **FREE** deal to introduce these wonder spark plugs in your territory. Write quick—today.

CENTRAL PETROLEUM COMPANY
1630 Century Building Cleveland, Ohio

CORONA FOUR

With standard office keyboard—an office typewriter in portable form.

Write for literature.
Corona Typewriter Co., Inc.
112 Main St., Grotton, N. Y.



Turn Your Ideas Into Money



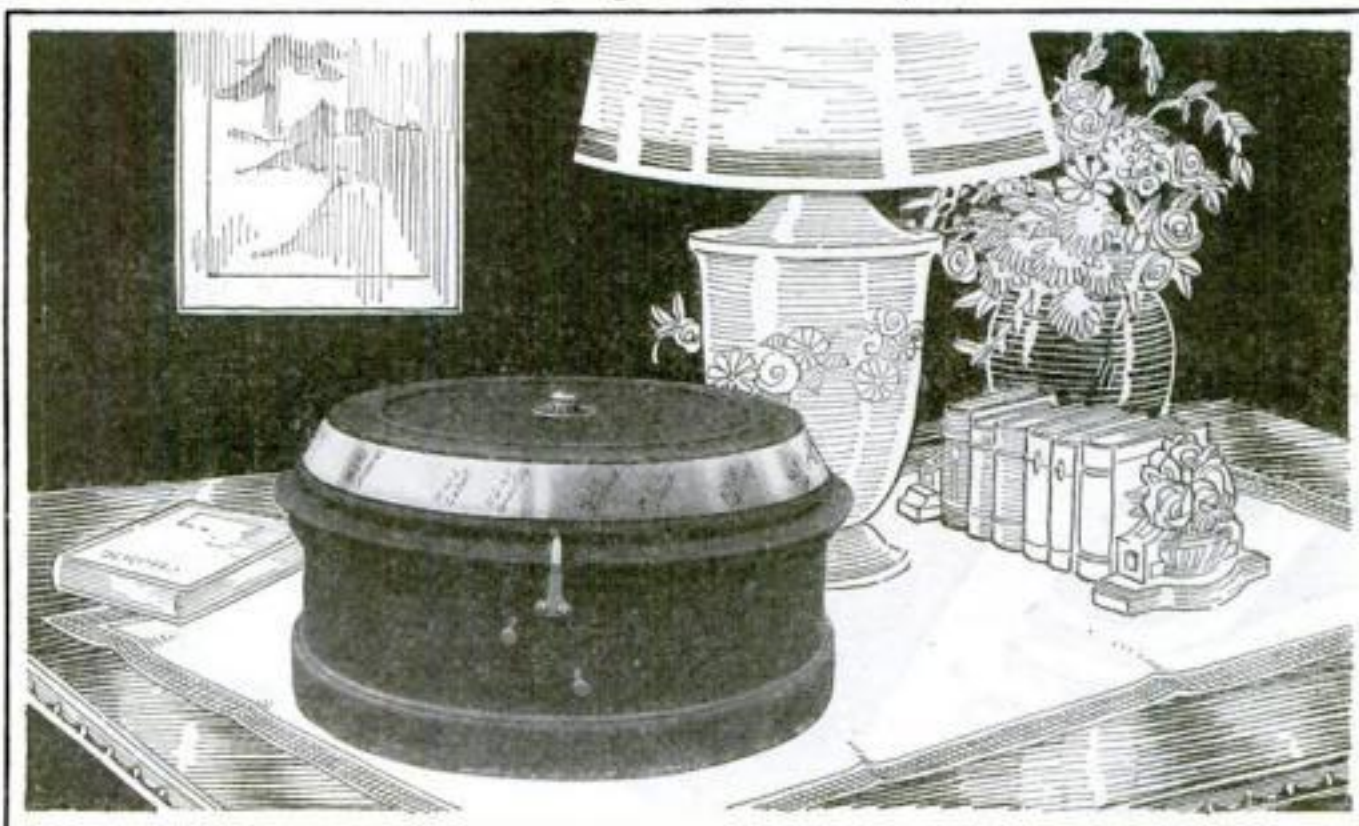
\$28. Complete line of accessories at equally low prices.
THE GEROLD COMPANY
Dept. PS-5, 120 Liberty Street, New York

Wade Bench-Lathe

Get cash for spare time, making patterns, working models, inventions. Save and earn money on repairs. A real machine tool for the home work bench. Cap. 4" dia. x 12" length. Accurate, compact. Price for lathe.

NO-DIAL

(Patented)
(for Storage or Dry Batteries)



Licensed under Blackmore Patents and Patents Pending, Hojan Patent No. 1014002

Revolutionizing Radio Operation

THE NEWEST THING IN RADIO!

"NO-DIAL" so simple in operation, so positive in performance, is just what you want

Dials are gone forever! Old-fashioned—obsolete! They served their purpose in the "radio pioneer days." Now up-to-date fans refer to them as primitive—pre-historic—"old-as-the-hills!"

Away with trouble, complicated tuning and puzzling operations! Scrap your log book! Forget your past disappointments.

For radio is SIMPLICITY itself now! Just what you predicted and everybody expected. You, who have waited for the "grief-less," and "worry-less" radio receiver, can buy NO-DIAL safely.

VISIBLE STATION RECORD

The NO-DIAL brings in stations far and near by merely rotating the cover. Each station comes in at a certain point. As stations are received they are recorded right on the cover (fig. 1) and thereafter they will always come in at the same point. Thus you have a *permanent* and *visible* station record which is positive and unfailing.



*Permanent Visible Station Record.
A touch of the finger brings 'em in.*

IT'S BEAUTIFUL

The NO-DIAL represents a complete departure in radio set design. It is housed in a compact, circular case finished in popular brown crystalline, a perfect match for most high grade loud speakers. Nothing to spot, scratch or mar. Easily cleaned with a damp cloth. Finally, it's trouble-proof and GUARANTEED.



NO-DIAL with cover removed.

LOUD AND CLEAR AS A BELL

The tonal qualities of the NO-DIAL will please everyone, due to the fact that they are directly caused by our latest combination in resistance coupled amplification. The tonal qualities are so sweet, so clear, so mellow! Harshness and interfering noises are absorbed and never reach the ear. Volume is regulated with a control lever. Far distant stations come in almost as distinctly as local. Results are positive and instantaneous.

Tube for tube, the NO-DIAL recognizes no superior, and on test it has out-performed many higher priced receivers. The NO-DIAL will do everything any other single control set will do, and more, as regards fine volume, long range and clarity of tone.

See your dealer TODAY and ask for a demonstration. You'll be amazed.

Five Tube No-Dial for Storage or Dry Batteries Type 5 and Type 5-D
(Less Loudspeaker and Accessories) Retail Price \$98

If your dealer cannot supply you write us for literature giving dealer's name and address.

The Ohio Stamping and Engineering Company, Dayton, Ohio, U. S. A.



The Season's Sensation

THE KODEL MICROPHONE LOUD SPEAKER is an exact replica of the transmitting microphone used in broadcasting.

The efficient Kodel reproducing unit, with an ingenious new snail-shell horn, mounted inside the microphone case, produces a remarkably clear, full-toned volume. Non-vibrating tone chamber eliminates distortion.

The \$15 model incorporates the new Kodel, Jr. unit; with the large Kodel unit, \$20

Radio dealers everywhere have them

THE KODEL RADIO CORP
500 E. Pearl St., Cincinnati, O.

\$15.00

The KODEL MICROPHONE LOUD SPEAKER

Design Patented

The Home Workshop

A "Two-Tone" Radio Cabinet

(Continued from page 104)

Pour white shellac into a dish and add about one-third as much alcohol. Apply this to each section separately, using long strokes and working very quickly, as the shellac sets almost at once. Do not try to go over or touch up any places you have missed. This one coat of shellac is sufficient for the inside of the cabinet except the inside surface of the cover, which should be finished fairly well, as it will show when open.

Give the cabinet four or five more coats of shellac, sandpapering and dusting thoroughly between each coat, as this is the secret of obtaining a good finish.



The removable battery compartment doors, which are given an attractive two-tone finish

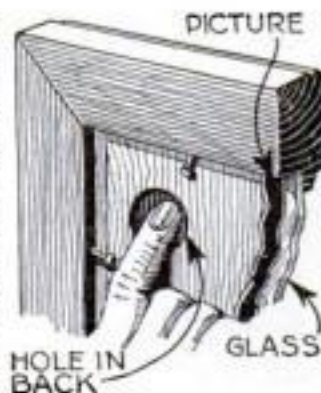
The last two coats of shellac need not be thinned. Allow several hours between coats for the shellac to dry and let the last coat stand overnight.

The next step is to polish the cabinet by saturating a clean, soft rag with the lemon oil, sprinkling a little powdered pumice-stone on the wood and rubbing it briskly with the oily rag until the finish appears to be smooth. This takes off the high gloss, but gives a rubbed effect with a moderate gloss such as often is seen on the most expensive furniture. Remove all the grit with a clean, dry rag. A nickel, silver, or gold-plated knob is fastened in the center of each door.

Finished in this way, the cabinet will always maintain its excellent appearance.

Simple Trick Aids in Squaring Picture in Its Frame

IN FRAMING pictures, the placing of the back piece of cardboard or wood often moves the picture itself a trifle so that it is no longer square with the frame. Every home worker who has attempted to frame pictures has experienced this difficulty. It can be overcome by a simple trick of boring or cutting holes in diagonally opposite corners of the back. Having placed the picture and back in the frame, drive in a few brads lightly, turn the frame over and then center the picture accurately by shifting it as necessary with the finger-tips through the holes. Then finish bradding down the back.—LOUIS SCHNEIDER, Clinton, Mo.



10¢ LEARN ELECTRICITY

A twenty-five cent book, "Electricity and Magnetism" key to electrical knowledge and small motor building. For a short time only

Knapp Electric Corporation
Dept. 108 Port Chester, N. Y.

10¢



Tool Cases

for Machinists, Carpenters and Tool Makers; none better; thirty styles. Quartered oak and metal covered. Ask for booklet.

"Built for Service"
The Pillied Lumber Co., Swanton, Ohio

LATEST WHOLESALE RADIO CATALOG

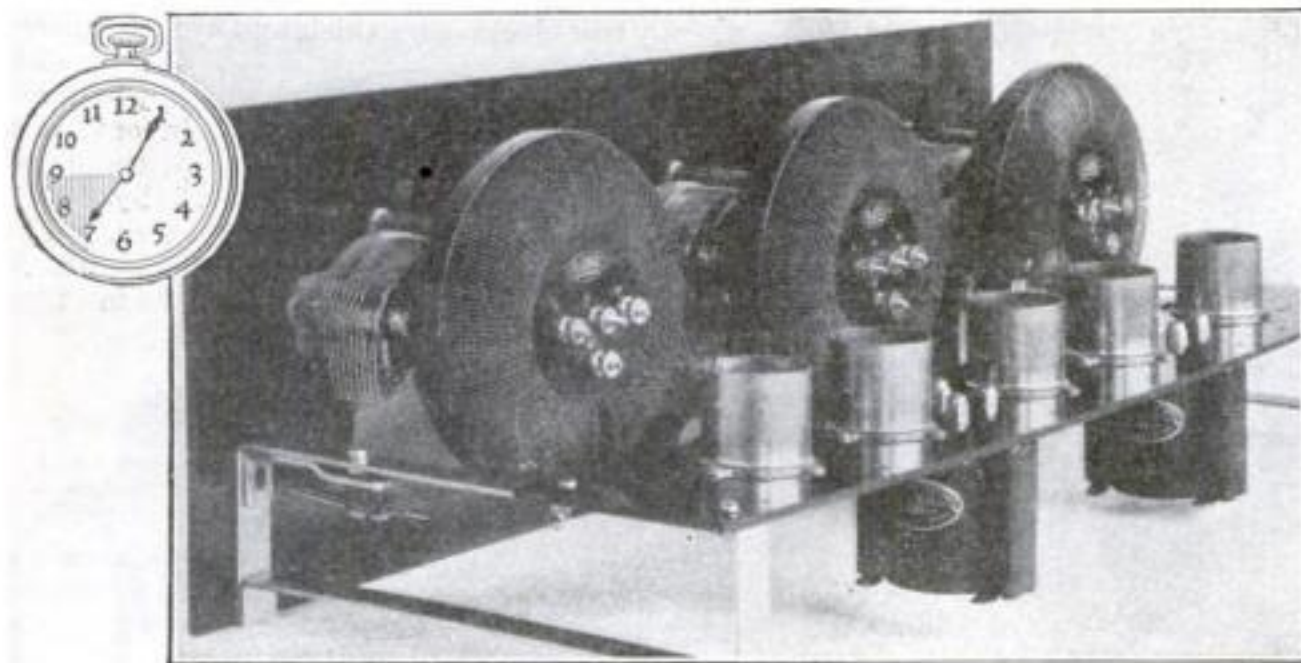
FREE Simply send name TODAY for big 48-page catalog of latest radio goods at Wholesale. Live dealers and agents wanted. STANDARD RADIO CO., 104 East 13th, Kansas City, Mo.

HAVE YOU AN INVENTION?

If so the WORLD PROGRESS will send you upon request sample copy Free containing Suggestions to Inventors as to Inventions Needed. We invite manufacturers to address us regarding inventions they want. Subscription for one year 60 cents. **WORLD PROGRESS PUB. CO., INC.** Room 202 Victor Bldg. Washington, D. C.

Build the phenomenal new type radio with one of these kits

Everyone wants one of these revolutionary receivers that are amazing engineers with their results. Designed on a newly discovered principle. Now you may build your own in a surprisingly short time from one of these remarkable kits. Send for new free book that tells how.



The new Erla Circlloid Five Factory Bilt Kit—as you receive it. Ready-cut, flexible, solderless leads and charts enable you to wire it in an evening. Price \$49.50

HERE is an easy way to have the new radio that is astonishing radio fans everywhere. You make a big saving and have the fun of building your own set besides. It takes only a short time—from 45 minutes to an evening—depending on the kit you select.

There are one to five tube kits at strikingly low prices. No wire bending or soldering. Merely set up the parts, then attach a few ready-cut flexible eyeletted leads and the job is done.

The amazing new inductance principle found in these kits is based on a different kind of coil—the Erla *Balloon *Circlloid. It belongs to Erla alone. No other set regardless of price, can offer it to you. Four striking advantages result.

1. Greater Distance. Circlloids have no measurable external field to affect adjacent coils or wiring circuits. This makes possible higher amplification in each stage, with increased sensitivity and greater range.

*Trade Mark Registered

Dealers—Exclusive franchises are available to high class dealers in localities still open. Write or wire immediately.



This sign identifies authorized Erla distributors. All are equipped to give complete radio service.

2. More volume. Higher r. f. amplification enables Circlloids to bring in distant stations scarcely audible in ordinary sets with volume on the loud speaker to fill an auditorium.

3. Increased Selectivity. Circlloids have absolutely no pick-up qualities of their own. Only signals flowing in the antenna circuits are built up.

4. Finer Tone Quality. The self-enclosed field positively prevents stray feed backs between coils. Hence no blurring or distortion. Tones are crystal clear.

Write for free information on kit—also book

See how a few minutes of fun will give you the newest and most phenomenal set known to radio science. Examine it at any Erla dealer's, or send the coupon for full information, illustrations and diagrams contained in the remarkable book, "Circlloid Hookups."

Erla Kit No. K-10



Consists of 3 Erla Balloon Circlloids (1 coupler and 2 transformers). Full instructions for installing on your present receiver are included. Price \$12.

Erla Kit No. K-13



Consists of 3 Erla Balloon Circlloid Coupler and Transformers and 3 .00035 15-plate Erla Mini-loss Condensers. Complete instructions for installing in each box. This combination gives you a splendid 5-tube receiver. Price \$21.50.

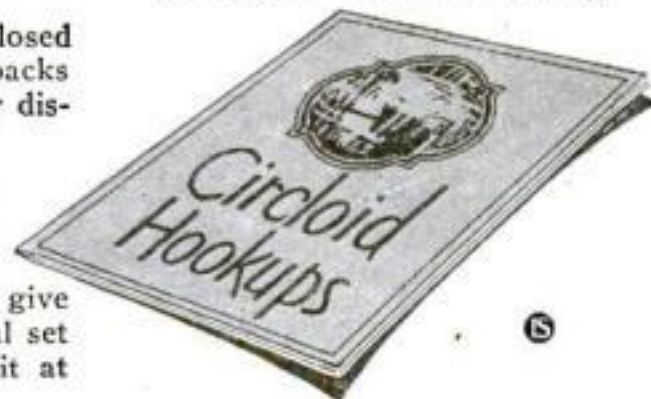
Erla 3 Tube Cir-Kit



Contains absolutely every part used in the construction of a 3-tube Erla receiver, from drilled and engraved Bakelite panel and stencilled baseboard to wood screws and wire. Every part tested and approved in our laboratories and guaranteed.

NOW FREE

Get this book telling about the newest scientific radio discovery. See the many circuits in which it can be used. Make the tests that prove the four great advantages it brings. The edition is limited, so write immediately.



Electrical Research Laboratories,
2500 Cottage Grove Ave., Dept. 12-A, Chicago, Ill.

Send me the new book explaining the revolutionary radio principle recently discovered; also various Circlloid hookups.

Name.....

Address.....

City.....County.....State.....

KLEIN PLIERS

That lamp has always needed a new shade and now it's going to get it! Easy enough with Klein Pliers. A pair of Klein's is a real worker and a real playmate. You'll enjoy them for making and fixing things all over the house—for your radio and auto, too. They're thoroughbreds, are Klein Pliers—the result of sixty-seven years of manufacture of pliers. Electrical and telephone companies all specify them. Pick up a pair when at your hardware dealer's.



Mathias **KLEIN** & Sons
Established 1858 Chicago, U.S.A.

A new Parks! Cabinet Shop Special

No. 7

\$250

As
Illustrated
with
motor



THE MOST POPULAR MACHINE PARKS EVER BUILT! A winner from the start. A real machine, yet convenient size for the small shop. Does everything in woodworking. Has circular rip and cut-off saw, 6-inch jointer, 16-inch bandsaw. Lathe and shaper attached if desired at small cost. Operates from any light socket. Just plug in and go to work!

Write for interesting circular

The Parks Ball Bearing Machine Co.

1547 Knowlton St., Cincinnati, Ohio
Canadian Factory: 200 Notre Dame East, Montreal, Canada

PARKS

WOODWORKING MACHINES

A Revelation in Tone—Volume—Clarity

The Kellogg Symphony Reproducer brings the broadcasting studio into your very room, so realistic is its reproduction.

Piano music, the most difficult to reproduce, sounds so natural that you are completely carried away by its beauty.

Vocal selections retain all of the tone colorings of the artist.

Orchestra music is indeed a recreation, every instrument can be heard, clear and full.

Magnetic diaphragm control—used exclusively in the Kellogg unit—is the new principle that performs wonders in radio reproduction.

Compare it with others at a like price and note the difference—\$20.00 each.

At your dealers—Hear one today.

**The Kellogg Switchboard &
Supply Company**

1066 W. Adams St. Chicago, Ill.

The Home Workshop

How to Make a Wooden Press for Pop-Corn Cakes

By Charles C. Hall,
Captain, U. S. A., Retired

POP-CORN bricks that can be eaten without sticking to the hands and giving off countless crumbs, can be made quickly and easily in the wooden press illustrated.

The materials required are a board 1 by 5 by 24 in., another 1 by 4 by 24 in., and a third $\frac{3}{4}$ by $4\frac{1}{2}$ by 20 in., all of which should be of oak or other hard wood; one piece of wood 1 in. square and 5 in. long, one piece $1\frac{1}{2}$ by 2 by 9 in., and two blocks 1 in. thick and $3\frac{3}{8}$ in. square.

Cut a notch $1\frac{1}{2}$ by 2 in. in one end of the 1 by 5 by 24 in. piece. Measure back from the



The crisp, delicious pop-corn bricks that children love so well can be made quickly in this simple wooden press



same end $8\frac{1}{2}$ in. and bore a $1\frac{1}{8}$ -in. hole. Taper off the other end for a handle.

In one end of the other 24-in. piece cut a similar notch. Measure 8 in. from the same end and cut a square cornered hole $1\frac{1}{4}$ by $1\frac{1}{8}$ in. At the other end form a handle.

From the 20-in. long board cut 4 pieces 5 in. long and after drilling holes, screw them together to form a box 5 in. square. Fasten this on the 1 by 5 in. piece previously prepared so that the hole is exactly in the center of the box.

Make a square cornered hole $1\frac{1}{4}$ by $1\frac{1}{8}$ in. in the center of one of the $3\frac{3}{8}$ -in. blocks and bore a 1-in. hole in the center of the other. One is the plunger and the other is the ejector block.

Bore $\frac{3}{8}$ -in. holes at each end of the $1\frac{1}{2}$ by 2 by 9 in. piece and corresponding holes in the ends of the handle pieces, so that they can be fastened together with $\frac{3}{8}$ -in. bolts or iron pins as shown.

Insert one end of the 1 by 1 by 5 in. piece in the hole or mortise in the upper handle piece and bolt or pin it in place.

(Continued on page 110)

Unconditionally Guaranteed THORDARSON *Super* AMPLIFYING TRANSFORMERS *Standard on the majority of quality sets*

Colin B. Kennedy says:

"We are cranks on audio-frequency transformers and our engineers are constantly running comparative tests on them. The fact that we continue to use Thordarson's exclusively, in ever increasing numbers, simply means that we believe that it is the best available at this time."

—from a letter dated May 29, 1925, written by Mr. Colin B. Kennedy, President of Colin B. Kennedy Corp., St. Louis, Mo.

Follow the Lead of the Leaders! Build or replace with Thordarsons

Leading set builders have scientific laboratory apparatus to test, compare and prove the facts about transformers. They continue to use more Thordarsons than all competitive transformers combined. Doesn't this answer the amplification question?

Daily we hear from fans who paid high prices for musically named, fancy-looking transform-

ers only to discover that their old standbys—Thordarsons—were the real musical instruments. For the benefit of others we therefore repeat "when better transformers can be bought they will be Thordarsons." Few, if any, transformers actually cost as much to make as Thordarsons. Why, then, pay more? Any store can supply you. If dealer is sold out, order from us.

TYPES AND PRICES



Thordarson Super Audio Frequency Transformers, sub-panel or top mounting types: 2:1, \$5; 3½:1, \$4; 6:1, \$4.50.



Thordarson Power Amplifying Transformers give best results when preceded by two stages using 3½:1 Thordarson A. F. Transformers. Pair \$13.



The Thordarson INTERSTAGE Power Amplifying Transformer. Provides two stages of POWER amplification when inserted in circuit between Input and Output Power Amplifying transformers. Four tubes are required, but the quality of the reception more than repays you. Only Thordarson builds a transformer of this type. Each \$8.

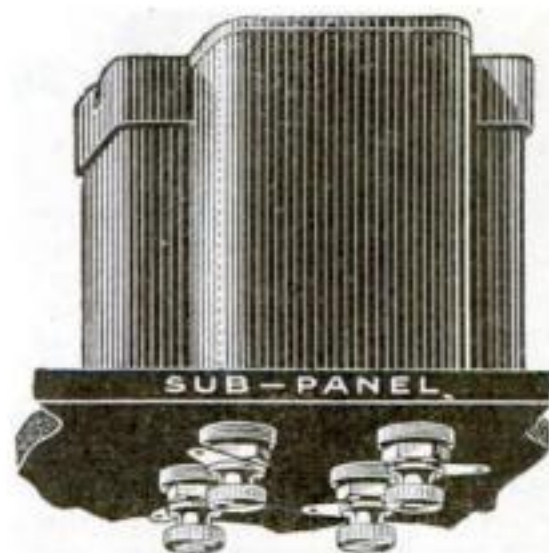
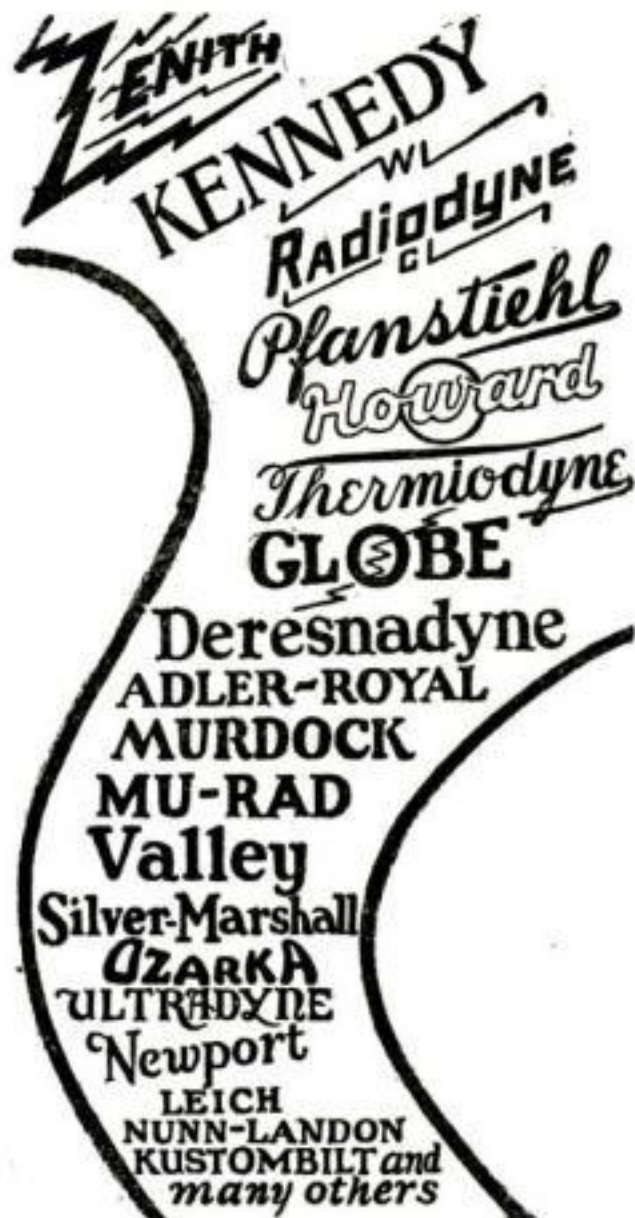


Thordarson Autoformers amplify clearly the lowest notes of any instrument as perfectly as the highest notes. They amplify with even magnitude all notes within range of the human ear. A new idea developed and perfected by Thordarson. Write for the Autoformer Hookup Bulletin. Autoformers are \$5 each.

Write for latest Thordarson bulletins on amplification. Thordarson dealers everywhere.

Super-Het Builders!

For the "Best" 45,000 Cycle Super-Heterodyne "Radio" and other leading authorities recommend in highest terms the Thordarson 2:1 Ratio Transformers. Take no others.



SUB-PANEL MOUNTING TYPE THORDARSONS NOW ON SALE

They permit a neater assembly, the shortening of leads and the concealing of wiring—as in factory built sets. Same ratios—same prices—as standard type Thordarsons. If dealer cannot supply, order from us.

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer specialists since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Chicago, U.S.A.



Pay Less for LATHES of Highest Quality

Built on the **SOUTH BEND** Standardized Production Plan

South Bend Lathes are modern Lathes—built in quantities and brought down in prices by modern manufacturing methods. They are as outstanding in quality, accuracy and performance as they are in price.

Prices Quick Change Gear Lathes	
9" x 3' Lathe \$241.00	15" x 7' Lathe \$447.00
11" x 4' " 288.00	16" x 8' " 498.00
13" x 6' " 366.00	18" x 10' " 721.00

Easy Payments if desired. Write for Catalog No. 84

South Bend Lathe Works, 818 E. Madison Street, SOUTH BEND, IND.



Only \$5

buys any WITTE ENGINE up to 10 H. P. Uses Kerosene, Gasoline, Distillate or Gas. Equipped with celebrated Troubleproof WICO Magneto. Simplest and cheapest to operate. New device makes starting easy. 25% or more surplus power. Sizes 2 to 25 H. P.—all styles. Sold direct from factory to you on **FREE BIG NEW ENGINE BOOK** **NINETY DAYS' FREE TRIAL.** Write today for my new illustrated engine book—sent absolutely Free. No obligation to you.

WITTE ENGINE WORKS
2228 Witte Building, - - - KANSAS CITY, MO.
2228 Empire Building, - - - PITTSBURGH, PA.



That Extra Pair of Hands



LET a Luther Vise be that "extra pair of hands" you always wish you had when you tackle a mean "fixing" job—whether it's taking apart a spark plug, loosening a rusted-on nut, or filing down a metal part of some kind. This sturdy, tight-holding vise has a wider jaw spread and a larger feed screw than any other vise of equal size, and has an extra-strong panelled slide bar. A clean-built, husky work-pal that never goes back on you—saves you many a skinned knuckle and makes any number of little jobs easier. Four sizes—jaw spreads of 1½", 2", 2½" and 3". Sold by most good hardware stores.

Write for free copy of interesting booklet, "Tighten Up", and name of stores near you that sell Luther Vises.

LUTHER GRINDER MFG. COMPANY
Department A Milwaukee, Wis.
Also Manufacturers of Luther Tool Grinders

Luther

QUALITY-BUILT VISES

21 Jewels!

Nothing less than 21 Ruby and Sapphire jewels is good enough for the BURLINGTON masterpiece.

1 DOWN Quality and Style

Adjusted to second-temperature — isochronism — positions, 25 year gold strata case, in 100 designs. Unsurpassed quality, rock-bottom prices. \$1 down brings your choice. Balance in small monthly sums.

Send for FREE Book
Write today for FREE Burlington Watch Book. Find out about this big special offer made for a limited time!

Burlington Watch Company
19th Street and Marshall Blvd.
Dept. 13-67 Chicago, Illinois



\$25
West of Rockies \$25.50
In Canada, \$35

The **SAAL** Soft **SPEAKER**

Volume with tone quality

You need no longer object to loud speakers because of their harshness. Hear the Saal at your dealer's today. It combines volume with a velvet tone. It's built to last a lifetime.

H. G. SAAL COMPANY
1800 Montrose Avenue • Chicago

The Home Workshop

Press for Pop-Corn Cakes

(Continued from page 108)

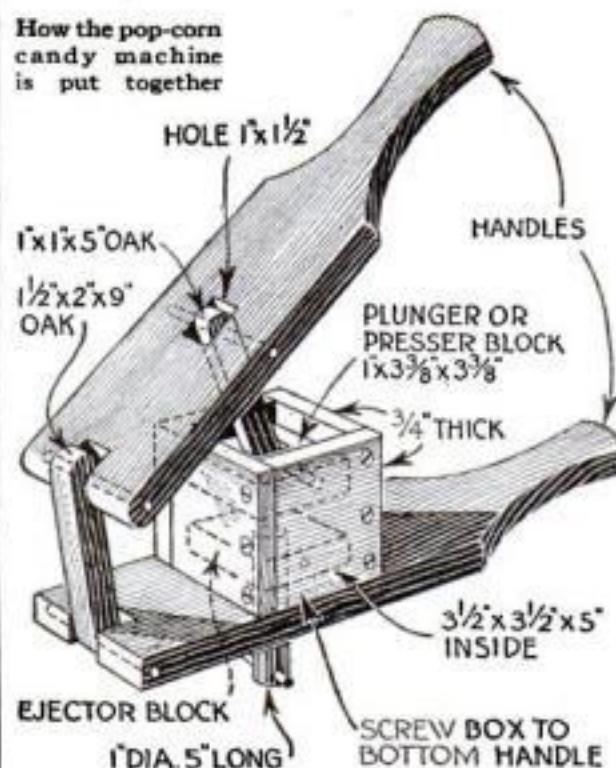
Fasten the other end similarly in the hole in the plunger block, using an iron pin.

Fasten a 5-in. length of broom handle to the ejector block and let it project through the bottom of the box.

To make about 18 bricks, pop 8 qts. of corn. Take 2 cups of molasses, ½ cup sugar, and 1 tablespoon of vinegar, and cook until the syrup hardens in water but is not brittle. If dark molasses is used, it is well to add ¼ teaspoon of soda to improve the color. Pour the syrup over the corn in a large vessel and stir.

Grease the square box with butter, fill it with sufficient corn to make a brick and press the handles together. Then push

How the pop-corn candy machine is put together



up the broomstick connected with the ejector block and remove the brick with a slight twist. The resulting brick, which will be about 1 in. thick and 3½ in. square, should be wrapped in waxed paper.

How to Repair Leak in a Copper Ball Float

THE COPPER ball float used in a bathroom flush tank sometimes springs a leak and fills with water. As it is difficult to find the leak by ordinary methods, punch a small hole in the float and blow into it hard enough to force the water out of the leaking hole. When the water has been removed in this way, it is a simple matter to solder both holes.—C. W. HUBERTZ.

Making Christmas Presents

YOUR home workshop never is more useful than when you are preparing for Christmas. It is not too soon to start work on the gifts you plan to make. You will find many suggestions in this issue and many more in the November and December numbers. There will be articles on toys, games, furniture of various kinds, jewel boxes, radio cabinets, kitchen equipment, greeting-cards, and novelties.

Again They said
it couldn't be done!

Here it is

New and Improved
**FRESHMAN
MASTERPIECE**

But now . . .

Complete with built-in loud speaker of great volume and superb tone quality.

Encased in . . .

As fine a heavy genuine solid mahogany cabinet as ever graced any radio set.



Model
5-F-5

At sixty dollars . . .

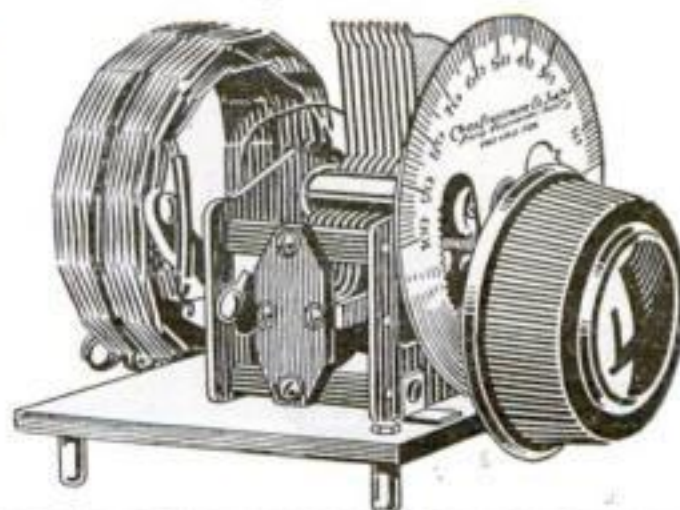
Not only complete with built-in loud speaker and massive mahogany cabinet, but this wonder circuit has been scientifically perfected and each and every single part strengthened and co-ordinated.

For example . . .

The new Freshman Masterpiece straightline wave length condenser with vernier attachment which assures hair-line selectivity—permitting you to tune in the station you want without interference over the entire wave length range. This is merely one exclusive feature of this New and Improved Freshman Masterpiece Receiver

For sale at AUTHORIZED FRESHMAN dealers only

Chas. Freshman Co. Inc.
Radio Receivers and Parts
FRESHMAN BUILDING
240-248 WEST 40TH ST.—NEW YORK, N.Y.
CHICAGO OFFICE — 327 S. LA SALLE ST.



\$60

And how!

Price 10% higher
West of Denver

The New Millers Falls Hand Drill

No.~

77

\$1.90



Read these specifications

Chuck—3 jaw—improved protected springs. Capacity 9 to 1 1/4" round shank drills. Cut gears; steel pinion. Malleable iron frame. Solid end handle and side handle, stained hard wood. Nicked chuck. Length—12 1/2". Weight—1 lb. 6 oz.

No. 77 is a great deal of hand drill for a small sum of money. It is a good tool—regular Millers Falls standard. Ask your hardware man to show it to you—and compare the tool itself with its amazingly low price. One of a complete line; no matter what your work, there is a Millers Falls Hand drill to suit you.

MILLERS FALLS COMPANY

Millers Falls, Mass.

28 Warren Street
New York9 So. Clinton Street
Chicago

Manufacturers of Mechanics' Tools, Hack
Saws and Automobile Tools



The Home Workshop

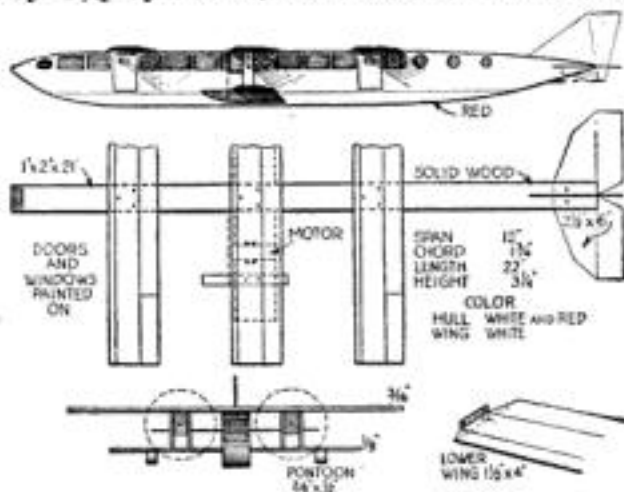
Toy Ocean-Going Air-Liner Made with Pocket-Knife



STILL longer than the aerial express cruiser described last month, but of a radically different design, is this toy model of an air-liner. It is of a type that some day may be used for crossing the Atlantic.

Like the other toys in the present series, of which this is the fifth, the model is made from odds and ends of wood and tin. Most of the work may be done with a pocket-knife.

Except for the tail members and the propellers of the two motors, the parts are wood. The three wings, which are 3/16 by 1 1/4 by 12 in., are nailed to the body.



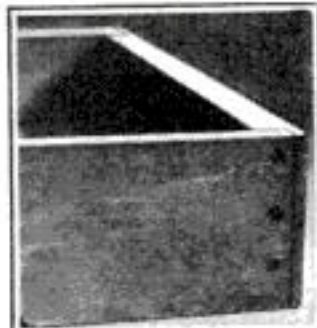
Side, top, and front views of the air-liner and suggestion for attaching lower wings

The lower wing, which is made in two halves, each 1/8 by 1 1/2 by 4 in., can be fastened to the hull in any convenient way. Perhaps the simplest is to use small metal angle brackets above and below each wing or to nail a flat piece of tin to the inside end of the wing and then attach the metal to the hull, as illustrated.

The other details of construction are made clear in the drawing and, of course, can be modified or altered in any way desired. The next and last article in the series, which will appear next month, will describe a small plane, or "air flivver."—DONALD W. CLARK.

Simple Joint for Drawers

WHILE dovetail joints are best for fitting the sides to the front of a drawer, they are hard to make, and amateurs usually fight shy of them. The joint illustrated is made much more easily. The side is set into a rabbet in the front, glued, and held with a couple of brads. Then holes are bored through the side into the front to take dowels, the number and size depending upon the dimensions of the drawer. Dowels of the same kind of wood as the drawer are made with the aid of a dowel plate and are glued in the holes, cut off, and smoothed.—H. C.



LEPAGE'S will mend it



WHEN you wish to mend or repair any article of useful value, do not risk using a cheap or inferior glue. You would not sew a silk dress with cotton. Why mend a broken article with an inferior glue? The cost of LePage's is nothing compared to the saving of making permanent repairs. Use LePage's Glue, the standard for 40 years. Insist on LePage's.

LEPAGE'S GLUE



RADIO Storage "B" Battery

32 Cells
32 Volts
Lasts Indefinitely—Pays for Itself

Economy and performance unheard of before. Recharged at a negligible cost. Approved and listed as Standard by leading Radio Authorities, including Pop. Radio Laboratories, Pop. Sci. Inst. Standards, Radio News Lab., Lefax, Inc., and other important institutions. Equipped with Solid Rubber Case, an insurance against acid and leakage. Extra heavy glass jars. Heavy, rugged plates. Order yours today!

SEND NO MONEY Just state number of batteries wanted and we will ship day order is received. Extra Offer: 4 batteries in series (96 volts), \$12.75. Pay expressman after examining batteries. 6 per cent discount 1st cash with order. Mail your order now!

WORLD BATTERY COMPANY
1219 So. Wabash Ave., Dept. 80 Chicago, Ill.
Makers of the Famous World Radio "A" Storage Battery
Prices: 6-volt, 100 Amp. \$11.25; 120 Amp. \$13.25; 140 Amp. \$14.00.
All equipped with Solid Rubber Case.

World STORAGE BATTERIES

Set your Radio Dials at 210 meters for the new 1500 watt World Storage Battery Station, WBSB, Chicago. Watch for announcements.



One Man Saws 15 Cords a Day!

—Easy with the OTTAWA Log Saw! Wood selling for \$3 a cord brings owner \$45 a day. Use 4 H.P. Engine for other work. Wheel mounted—easy to move. Saws faster than 10 men. Shipped from factory or nearest of 10 Branch houses. Write for FREE Book—"Wood Encyclopedia"—today.

OTTAWA MANUFACTURING CO.
1801-T Wood Street Ottawa, Kansas
Room 1801-T Magee Bldg., Pittsburgh, Pa.



GEARS All Kinds—Small

The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.

Write for Catalogue 214
CHICAGO STOCK GEAR WORKS
105 South Jefferson Street Chicago

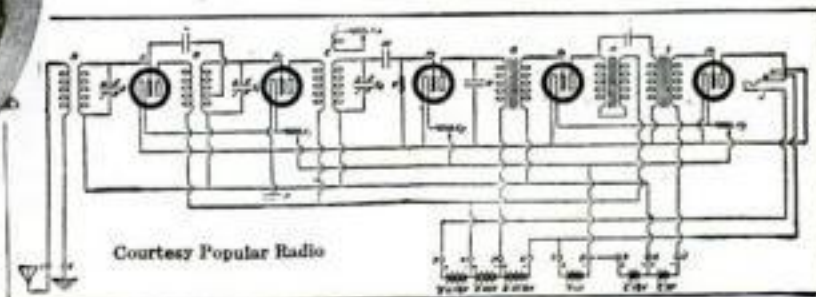
Tuned
Radio
Frequency
Kit
\$12.00
Complete
with
Brackets



The complete Low Loss Inductance System, comprising two tuned circuit transformers and an antennae coupler with a uniquely constructed variable primary for governing the selectivity of the antennae circuit.

NOW—All the world can have it!

The sensational favor which Chicago and New York showered upon the AERO COIL has prompted its designers to make it available to every fan in the Nation. Vigorous plans are, therefore, under way to place the Aero Coil where every city and village can see it and witness its markedly superior performance.



Acclaimed by Chicago and New York for its greater SELECTIVITY, POWER and SENSITIVITY!

Enjoy the "knife-edge" selectivity with which Aero Coils cut through the tangled mass of Chicago and New York broadcasting at will! Enjoy the uncanny sensitivity with which sets built of Aero Coils pick up the far off, small, low-wattage stations that you never thought existed! Be thrilled by the amazing volume with which Aero Coils amplify for the loud speaker, reception which you have always had to listen to on the head phones! Build a 5-Tube Tuned Radio Frequency Set with Aero Coils the true low loss inductance system.

PATENTS PROTECT ITS SUPER-EFFICIENCY

Its lower circuit resistance, its lower high frequency resistance, its lower distributed capacity, and the fact that its dielectric is 95% air are the reasons why the Aero Coil tunes so sharply into resonance—and why it actually uses the energy which other types of inductances waste. Hence, Aero Coil is the inductance of today—and tomorrow, and you can be assured that it is—for the construction which makes it the ideal inductance is patented, and no inductance can be made like Aero Coil unless in violation of these patents!

95% Air dielectric—No dope on windings—All turns air-spaced—Solonoid (cylindrical) windings—Variable primary. Engineers recognize cylindrical winding to be superior to any other. The Aero Coil is the only Air dielectric cylindrical inductance with a variable primary. Aero Coil patents prevent imitation.

Build Your Set Now!

The construction which makes possible the far superior results obtained from Aero Coils also makes them cost a bit more—but, performance considered, their price is low. \$12.00 for a set of three, complete with nickel plated mounting brackets which fit any condenser. Go to your dealer's today and obtain a set of three. A circular containing complete hookups for building a more selective, more sensitive, more powerful five-tube receiver is enclosed in each package.

If your dealer has not yet obtained his stock of Aero Coils, order direct, enclosing price with your order.

Free Booklet showing new circuits and giving full constructional information of help to any fan or set builder—mailed on request. Write for the Aero Booklet.

AERO PRODUCTS, Inc.
217 North Desplaines Street, Chicago, Illinois

Successors to
HENNINGER RADIO MFG. CO.

Pacific Coast Representative
S. A. WINSOR, 1221 W. 16th St., Los Angeles

AERO COIL

All Aero Coils embrace a patent-protected method of construction which makes possible a far more efficient inductance performance than is possible with other types of coils.

Use AERO COILS Wherever An Inductance Is Required

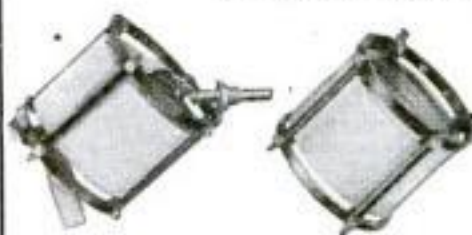
THE ONLY AIR DIELECTRIC COILS HAVING
VARIABLE PRIMARIES IN ANTENNAE
CIRCUITS

The Aero Coil 3-Circuit Tuner



a 3-tube set brought in Havana, Cuba, in the daytime in Chicago. Price \$5.00

The Aero Coil Radio Frequency Regenerative Kit



Consists of one AERO COIL 3-Circuit Tuner and one AERO COIL Antennae Coupling Transformer. Makes a more powerful, more selective 4-tube, non-radiating set. Price \$11.00

The Aero Coil Wave Trap Unit Also for Crystal Sets



By reason of the characteristics made possible by the Aero Coil construction, this unit makes a very efficient wave trap or crystal set. Price \$4.00

The Aero Coil Oscillator for Super Heterodynes



The characteristics achieved through the use of the Aero Coil principle make of this instrument the ready means to tremendously increase the efficiency of the oscillator circuit in any Super Heterodyne receiver. Pr. \$5.50

Prepared by KIRTLAND-ENGEL ADVERTISING COMPANY - CHICAGO



How to Pick a Hammer

YOU'RE proud of your personal kit of tools. Every "regular fellow" is. And so it pays to be especially particular when selecting the tool that's most in evidence because most used—your hammer.

Before you buy a hammer balance it in your hand; heft it; swing it. Has it a "hang" that makes you itch to come down on a nail and drive it home?

Is the head *press-forged*, not drop-forged? Has each end of the head a special temper to best fit it for the work it is intended to do? And the handle, is it of clear hickory, free from knots or blemishes, and not stained to cover up imperfections? And is it put on for good?

There's only one hammer that answers "yes" to all these questions. But it's easy to identify. The name "D. Maydole" is stamped on the head. Be sure it's there before you buy.

Your dealer sells and recommends the genuine Maydole Hammer. Ask him to show you the size and style you want.

Have you a copy of our interesting Handbook and Catalog No. 23 "B"? If not, send us your name and address.

THE DAVID MAYDOLE HAMMER CO.
Norwich, New York



The Home Workshop

Winners in Profitable Home Workshop Job Contest

WHAT the average home workshop is worth in dollars and cents—the money that is saved or earned through it—was demonstrated more vividly and impressively than ever before in the contest for POPULAR SCIENCE MONTHLY's readers on "My Most Profitable Home Workshop Job." The response was exceptional both in the number of letters received and their generally high standard of excellence.

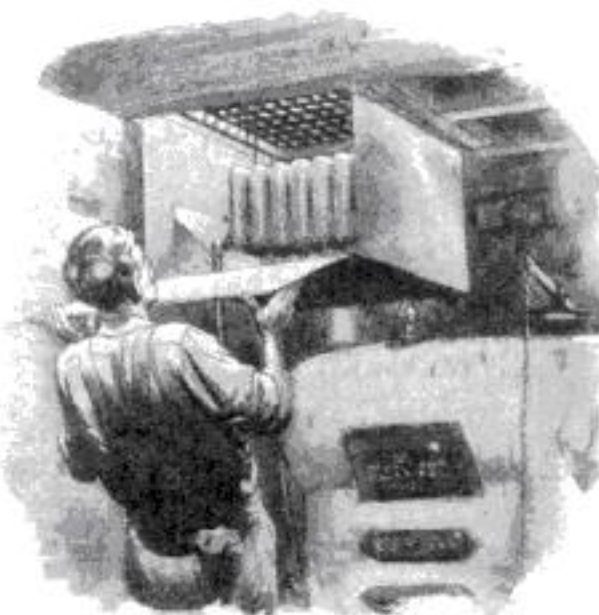
The winners are as follows:

First Prize, \$25, Theodore F. Geltz, Massillon, Ohio

Second Prize, \$10, R. L. Hankinson, Dayton, Ohio

Third Prize, \$5, P. A. Whear, Rock Island, Tex.

Ten Prizes, \$1 each: Gordon Holford, Gladstone, N. M.; J. E. Swanger, Santa Ana, Calif.; A. F. Duncan, New West-



First-prize winner installed a heating plant

minster, B. C., Canada; John Mitchell, Point Pleasant, N. J.; Edward B. Smith, Mullen, Tex.; Kelley Lewis, Longmont, Colo.; Harry P. Botsford, Portland, Oreg.; H. Caldwell, Toronto, Ont., Canada; D. H. Frew, Lisbon, Ohio, and M. L. Brooks, Tonkawa, Okla.

Honorable Mention: J. G. Pratt, Washington, D. C.; Russell E. Oakes, Waukesha, Wis.; B. E. Foster, Lakewood, Ohio; F. A. Coffill, Hantsport, N. S., Canada; L. M. Evans, Haigler, Nebr.; James G. Walsh, Dunmore, Pa.; J. S. Daver, Bombay, India; J. H. Dorn, Dresden, Ohio; H. D. Smith, Nyack, N. Y.; Mrs. J. M. Drane, Louisville, Ky.; David B. Hendrix, Byington, Tenn.; Alex C. Fabris, San Antonio, Tex., and E. F. Matheson, Utica, N. Y.

The first, second, and third prize-winning letters follow.

Installing a Heating Plant

By THEODORE F. GELTZ

Massillon, Ohio

First Prize

TO ECONOMIZE when building 10 years ago, we chose a hot-air heater, but soon learned that a change was desirable. Four years ago an opportunity

(Continued on page 116)

PRACTICAL BOOKS

THAT WILL

RAISE YOUR PAY

WRITTEN in easy-to-understand non-technical language these books will help you in your chosen trade. Every book is an entire course of instruction condensed into one volume. Thousands of men have used them to increase their pay. You will find them full of information and ideas that will help you raise your pay.

Painting and Decorating

Ross Crane Book of Home Furnishing and Decoration.....	Cloth	\$3.00
House Painting Methods with the Brush and Spray Gun, by Vanderwalker.....	Cloth	\$2.00
Interior Wall Decoration, by Vanderwalker.....	Leatherette	\$4.00
The Mixing of Colors and Paints, by Vanderwalker.....	Cloth	\$2.00
A Show at Sho Cards.....	Cloth	\$4.00
Sign Painting, by Atkinson.....	Cloth	\$4.00
Strong's Book of Designs.....	Leatherette	\$4.00
Modern Painter's Cyclopedia Cloth		\$2.00
Automobile Painting.....	Cloth	\$1.50
New Hardwood Finishing.....	Cloth	\$1.50

Steam Engineering

Swingle's Handbook for Steam Engineers and Electricians.....	Leatherette	\$4.00
Examination Questions and Answers for Marine and Stationary Engineers.....	Leatherette	\$2.00
Steam Boilers.....	Leatherette	\$2.00
Swingle's Catechism of Steam, Gas and Electrical Engineering.....	Leatherette	\$1.50

Carpentry Books

Cloth Binding		
Modern Carpentry, 2 vols.....		\$3.00
The Steel Square, 2 vols.....		\$3.00
Modern Estimator.....		\$1.50
Timber Framing.....		\$2.00
Builder's Architectural Drawing.....		\$2.00
Concretes.....		\$1.50
Practical Bungalows.....		\$1.00
Roof Framing, by Van Gasbeek.....		\$1.50

Electrical Books

Telephony, Including Automatic Switching, by Smith, 450 pp.	Leatherette	\$2.50
Practical Applied Electricity.....		\$2.00
Wiring Diagrams and Descriptions.....		\$1.50
Armature and Magnet Winding.....		\$1.50
Electric Motors, D. & A.....		\$1.50

CHECK

—the books you want and mail today with your remittance.

We will send you the books you order on our guarantee that if you are not thoroughly satisfied with them we will return your money.

POPULAR SCIENCE MONTHLY
250 Fourth Avenue
New York

POPULAR SCIENCE MONTHLY

Gentlemen:

Please send me the books I have checked for which I enclose my remittance of \$..... I am ordering these books on the basis that if I am not satisfied my money will be refunded.

Name.....

Address.....

The UTAH line

Trade Mark Registered
Made in Salt Lake City

SPEAKS FOR ITSELF

MADE OF HARD RUBBER

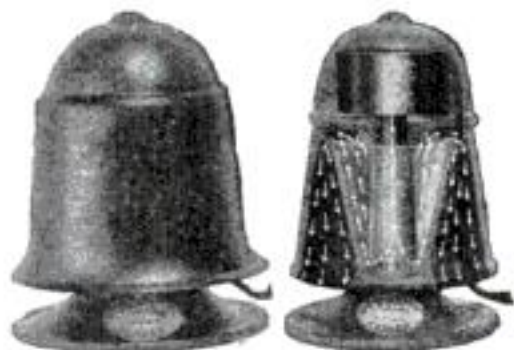
The guaranteed loud speaker

Utah's supreme loud speaker. We say it to be the best manufactured in the United States today.

Ask the man who has one.

We are manufacturers—not assemblers.

Make the Utah booth your headquarters while at the World's Fair Radio Show, New York, Sept. 15-19 and in Chicago at Fourth Annual Exposition Nov. 17-22.



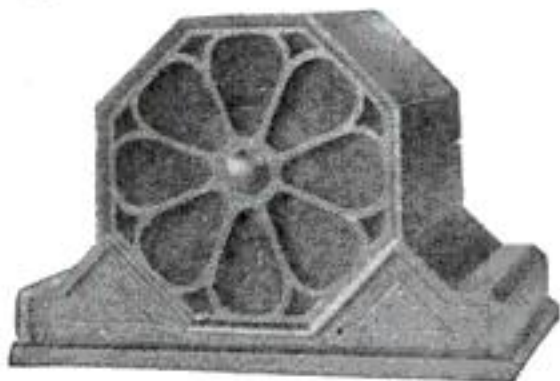
THE UTAH SUPER-FLEX. The Super-Flex has a tone chamber equal to that of the usual horn type. Stands but 8½ inches high by 6 wide. Finished in a harmonious brown. Weight 3 pounds.

Price \$14.00



THE UTAH STANDARD. Horn is finished in rich semi-dull black Morocco leather finish, 14-inch bell. Weight 1½ pounds.

Price \$25.00



THE UTAH SUPREME. Finished in a soft antique mahogany, designed to please both eye and ear. Measures 10½ x 8 x 7½. Weight 8 pounds.

Price \$25.00



THE UTAH PHONOSPEAKER. Handsomely finished in black rubber. Furnished with stand to rest on turntable of talking machine, or without.

Price with Stand \$10.00

Without Stand \$9.50

UTAH RADIO PRODUCTS COMPANY

Dept. 516

1427 S. Michigan Avenue

Chicago, Illinois

It is Easy to Shop by Mail and It Saves You Money!

SPEEDY SERVICE

SPLENDID VALUES

Ask Our Customers
—there are many in Your Community—

Outer and Inner Clothing and Shoes for All the Family—Dry Goods—Rugs—Jewelry—Furniture

Auto Supplies—Sporting Goods and Radio Supplies—Paints—Hardware—Stoves—Furnaces—Farming Tools

Many of our Orders are Shipped the Same Day we Receive them—8 Hour Service—and practically all of the balance on the following day—24 Hour Service

The Charles William Stores
The Long Established Mail Order Merchants of New York City

518 Page Handy Catalog sent free on request to 385 Stores Building

1/2 SAVED on all Standard Typewriters

10 Days Trial

At Last—
World's best typewriters with every modern writing feature at positively lowest prices and on easiest terms ever offered.

A Year to Pay—5 Years Guarantee
Standard Machines so perfectly Re-Manufactured by the exclusive Young Process that they look and write like brand new. Our exclusive, distinctive process makes possible better typewriters at lower prices.

FREE BIG ILLUSTRATED TYPEWRITER BOOK
Write now. See our amazing typewriter bargains. Read what users say and the unusual service we will give you. Don't wait. Write today.

Young Typewriter Company
654 West Randolph Dept. 142-A Chicago, Ill.

BARGAINS!
SAVE 1/3 TO 1/2
WRITE FOR CATALOG
RANDOLPH RADIO CORP.
159 N. UNION AV. Dept. 3 CHICAGO, ILL.

Getting Ahead?
Read the advertisements on Pages 146 to 174 this issue if you want to get ahead!

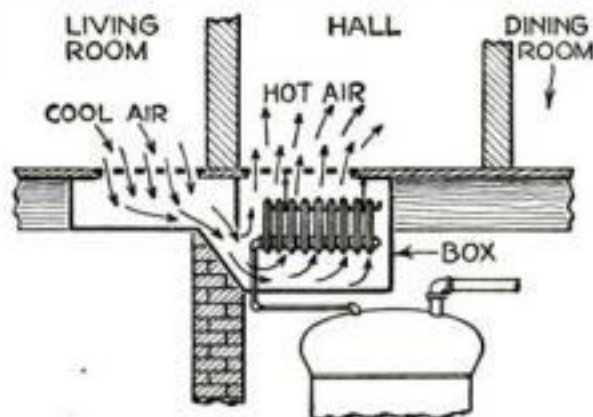
The Home Workshop

Profitable Job Contest

(Continued from page 114)

was afforded for purchasing a new 23-in., seven-section round steam boiler and 9 radiators. These were installed after the hot-air furnace had been sold.

The problem was to heat a garage and a seven-room house with a hallway too narrow to receive a radiator. Hall and living-room had adjacent cold-air registers. To heat the hall and open stairway, a radiator was hung beneath the hall register and incased, receiving cold air through the living-room register and wall and emitting hot air in the hallway.



Steam radiator suspended below an old hot-air register to warm a very narrow hallway

I rented a set of pipe-cutting tools and bolted the vise to a post in the basement where all the pipe was cut, and threaded.

Nine registers were set, single-line connected, and a pipe radiator was assembled for the garage. An electric thermostat with an eight-day clock and a motor were added and connected with the lighting line, the clock serving also as a dining-room timepiece.

A conservative estimate of the total cost of the system, excluding labor and deducting the \$80 for the furnace and pipe sold, and allowing for old material, shows approximately \$500 saved.

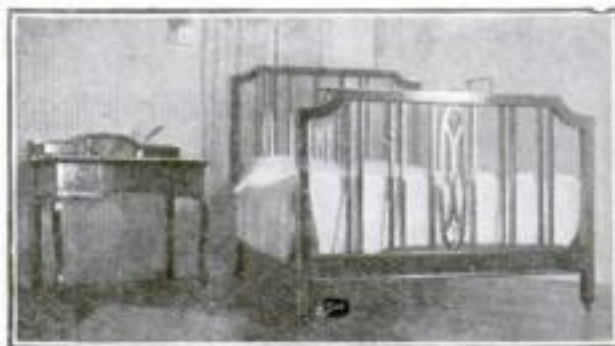
I am now 66 years old and never learned or worked at a mechanical trade, my own being coal-mining. For many years, however, my occupation has been bookkeeping. The installation of this system was accomplished alone, except that my wife shifted blocks while two large radiators were moved up the stairway.

Mahogany Bed and Desk

By R. L. HANKINSON

Dayton, Ohio

Second Prize



COULD I do it? The president of our company, my wife, said I could, and with this encouragement I decided to try.

The time of this incident was immediately following the World War when the

(Continued on page 118)

MEN!



PICK UP THIS EASY SPARE TIME MONEY And Get

Your Own Shirts FREE

Here is an amazing easy way for you to make \$5 to \$10 every evening after work. Our wonderful new shirt line contains the most attractive styles in silk, linen, madras, etc., and can be sold 50% cheaper than store prices. We will furnish you a free sample line and tell you exactly what to do to make big money this way. We tell you exactly what to say.

You receive your profits in advance—we deliver and collect. Write at once for free territory offer. No obligation. But act quick. Address **Charles Hope, FASHION WEAR SHIRT CO.** 1200-20 Jackson St., Dept. M-171 Cincinnati, Ohio

W. H. Adams, Dayton, Ohio writes:

V. A. Marini, Santa Cruz, Cal. (Nov. 1924) reports \$11,275 sales in 3 months. Alexander, of Penn., \$3000 profit in 4 months. Ira Shook, Flint, \$365.75 in 1 day. Bram, bought one outfit, then 10 more within a year. Mrs. Lane, Pa., sold 8000 packages in 1 day. J. R. Bert, Ala., "only things I ever bought that equaled advertisement." Patillo, Ocala, writes: "Crispettes all you claim." Kellog, \$700 ahead in 2 weeks.

\$351.00
Cleared in one day (Aug. 1925)



WE START YOU IN BUSINESS!

Furnish secret formulas, raw material, and equipment. Small capital required; no experience needed.

Build Business of Your Own

No limit to the sale of Crispettes. Everybody likes them. It's a delicious food confection made with or without sugar. Write for facts about a business that will make you independent. Start in your town.

Profit \$1000 Month Easily Possible

Send postal for illustrated book of facts. It contains enthusiastic letters from others—shows their places of business, tells how and when to start, and all information needed. Free. Write now!

Long-Eakins Co. 1047 High St. Springfield, O.



Agents \$2 to \$25 a day

NEW SELLING SENSATION

Take orders for famous Stay-Prest Trousers Presser. Puts perfect crease in pants—takes out wrinkles and baggy knees. Sells quick to men and housewives. Newest thing out. Big repeater.

FREE SELLING OUTFIT

Profits in advance. Ames made \$24 in 4 hours. Randle sold 33 first day. Special Offer gives you Selling Outfit absolutely FREE. We guarantee you will make sales. Write for plan and exclusive territory. Act quick. Get Free Outfit. The Getgey-Jung Co. R143C. 814G. Cincinnati, O.

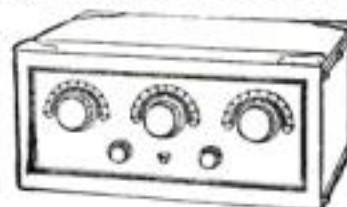


Thorola Loud Speakers with new burnished Bakelite horn and gold throat-band are even better in appearance and performance.



Thorola Low-Loss Doughnut Coils installed in your present set will give you many of the greatest Thorola advantages.

Thorola 4.....\$25 Complete set (3) \$12
Thorola Jr.....\$15 Per coil.....\$4



The very proportions of Thorola Cabinets suggest new internal design.

In smart Thorocco Cabinet the 5-tube Thorola Isodyne is \$85

In stunning Barled Walnut Cabinet with Circassian top the 5-tube Thorola Isodyne is \$115

ANNOUNCEMENT

This is of interest to opera-goers, to lecture and symphony patrons as well as to the dancing set, and to those scientifically interested.

Artistic radio has come with Thorola Isodyne, embodying the *Isolated Power* principle made possible only by Thorola Low-Loss Doughnut Coils. They conquer "pick-up" of unwanted stations, waste of power, uncontrollable "oscillation," freak wiring, uncertain operation. Radio experimenters know what all this means. Radio listeners no longer need to know!

With Isodyne action any one station wanted is cleanly selected, even in broadcasting centers. Utmost power is *isolated—focused*—on this one set of signals only. The delicate radio impulses do not conflict, neutralize, offset each other. Full tone, unmodified—full volume, full distance at last are possible, at all wave lengths.

With temperamental factors banished, Thorola Isodyne achieves uniform reception. The same stations keep coming in the same. The set your dealer demonstrates tells what your set will do.

Radio reception is unmistakably elevated. There is a complete Thorola receiver leading its field by far, just as Thorola excels in loud speakers and apparatus.

The Thorola name is surety of radio development not to be eclipsed. The intense interest in the 5-tube Thorola Isodyne at every radio store will tell you where expert opinion centers today. Go and listen.

REICHMANN COMPANY, CHICAGO

Thorola
ISLODYNE

Gauging the Good in New Machines

Can you see the good in new machines and show up their possibilities? Can you gauge what they're good for, production-wise?

Veeder Counters rate machines by the actual figures on production-rate.

Here's your proof of work-capacity, and pointer to greater capacity. Each new step toward a better machine counts for what it's worth on your

Veeder COUNTER

The small Revolution Counter below registers one for a revolution of shaft, recording a machine operation or product. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines and most adaptable to experimental work. If run backward the counter subtracts. Price

\$2.00. (Cut 4-5 size.) Small Rotary Ratchet Counter, to register reciprocating movements of small machines, also \$2.00.

Here's the handiest instrument for finding revolutions-per-minute of a shaft or flywheel. You hold the tip of the counter against end of revolving shaft; press lightly when the second hand of your watch comes to 0; release pressure when minute is up. A spring clutch controls the recording mechanism.



(Cut less than 1/2 size)

The Veeder Speed Counter enables you to keep motors, engines, generators, line shafting and machines operating at efficient speeds. Price, with two rubber tips, (as illustrated) \$3.50.

FREE: The 80-page Veeder booklet of Counters, to help in your development-work.

The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.

The Home Workshop

Profitable Job Contest

(Continued from page 116)

price of furniture was at its peak. The need for action arose when my wife desired some new furniture for her guestroom.

With an order for a mahogany bed on my book, I started my furniture factory in the basement of our home. My equipment comprised a workbench and a few hand tools. The plans consisted of an illustration cut from an advertisement.

I went to a dealer in second-hand building material and secured enough mahogany to make the bed. Some of it was so black and dirty it was scarcely recognizable. The cost of the lumber, cut to rough dimensions and delivered at my home, was \$1.75. The cost of stain and varnish made the total cost of material for the bed approximately \$3.50. The scrollwork was done on a small jig-saw, which I had owned since boyhood.

The spinet desk to match the bed, I considered a more difficult job, and for this reason I made a full-sized layout on paper. I purchased new mahogany for it at a cost of \$6.50. Other extras cost about \$1.

On figuring up the results, I found that I had converted material costing approximately \$11 into furniture that, if purchased, would have cost at least \$125.

Enameled Kitchen Cabinet

By P. A. WHEAR

Rock Island, Tex.

Third Prize

WHILE carpentry is not my line of business, I take great pleasure in making different pieces of furniture for the home in what spare time I can find. So the department that interests me



Home Workshop Blueprint No. 5 was used by P. A. Whear in making this kitchen cabinet

most in your monthly is the Home Workshop. I have made quite a few pieces

(Continued on page 120)

An Easily Made Smoking Cabinet

EVERY man who works with tools—whether he is a novice or a "handyman" with long experience—will find it easy to build this handsome smoking cabinet.

Space for cigars, cigarettes, match boxes, cigar and cigarette holders and pipe cleaners are provided. A feature that every smoker—and his wife—will appreciate is the ash trays (which are removable) at both ends of the cabinet. When not in use these ash receptacles can be closed.

Blueprint, including full details for making this handsome smoking cabinet, can be secured by sending 25c to—

Popular Science Monthly

250 Fourth Ave.

New York



SALESMEN-You

Have Wished for This
A Thousand Times

No wonder 99 men out of 100 say we have the greatest proposition ever. Our starting new selling plan is a "knockout"—it's different. Our 3 high-class specialties sell to every single man over 18 years of age whether he is digging ditches or running banks. They are new. Guaranteed. Our men often make \$5.00 profit in a single hour. Many make \$50 in a day. Over 50 per cent profit on every sale—besides we deliver and collect. Sales repeat automatically. No experience. Get FREE, full details of our amazing sales plan and our friend-making products. Earn big money. Write today.

RHODES MANUFACTURING CO., Inc.
P-242 Pendleton & Cozens, St. Louis, Mo.

SPORT BODIES \$34.50

For Ford or Chevrolet

We can furnish you with the latest style roadster or racing body at prices that will surprise you. These bodies may be used with or without top or windshield or fenders, and may be underlaid if desired.

Write for Our Book HOW TO BUILD A FORD RACER 25c

CENTRAL AUTO SUPPLY CO. Dept. LOUISVILLE 122 KENTUCKY

FREE—Our 64-Page Catalogue. Filled With Radio Bargains. Write Today!

RANDOLPH RADIO CORP.
159 N. UNION AV. Dept. 3 CHICAGO, ILL.

The Real Estate Educator

This book gives a most comprehensive yet most concise arrangement of useful facts about buying, selling, leasing and sub-letting of Real Estate, contracting, for erection or repairs, mortgaging, transferring, insuring, etc. Cloth, 256 pages. Price \$2.00, postpaid. Popular Science Monthly, 250 Fourth Avenue, New York City.

ANNOUNCING

the

new

RATHBUN

STRAIGHT LINE FREQUENCY CONVERTER

THE modern radio receiver has abundant tone, volume and power—now it may have *perfect, simplified control*.

The Rathbun Straight Line Frequency Converter is adapted for use on your receiver—every receiver—without change of equipment—except the condenser dials. Each station is given

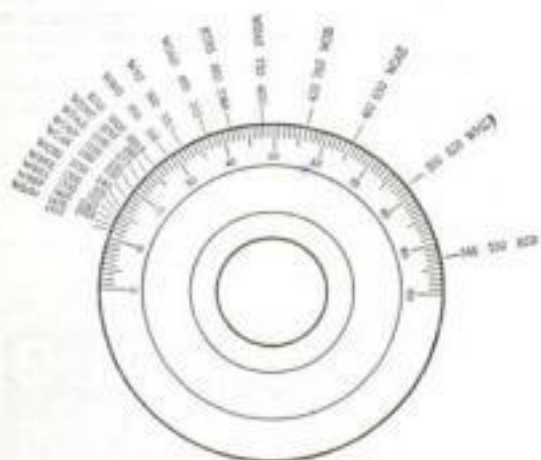
a distinct reading at a uniform distance from the next. Real logging becomes a fact. The stations are distributed with flawless precision over 360°—one complete revolution of the Dial. There is no limitation or crowding as on controls using only half a dial. Radio control is simplified.

The Rathbun Straight Line Frequency Converter provides straight line frequency tuning with ordinary capacity condensers. It is interchangeable with any dial—on any receiver. It is sold with the guarantee of reliability and satisfaction attached to all Rathbun Radio Apparatus.

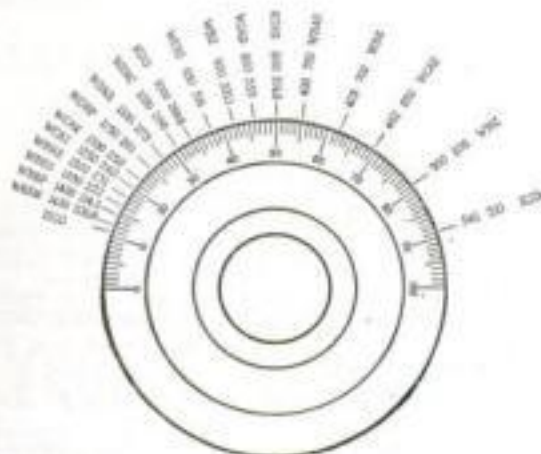
See and Try it—at Your Dealer's

If your dealer cannot supply you, send Money Order (\$3.50 each) and your order will be shipped promptly by Parcel Post prepaid.

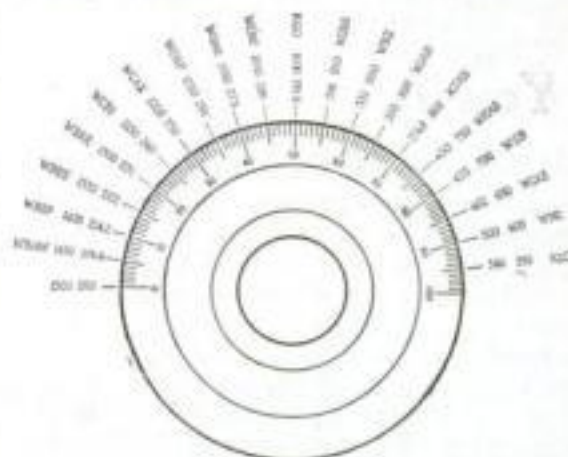
Rathbun Manufacturing Co., Inc.
Jamestown New York



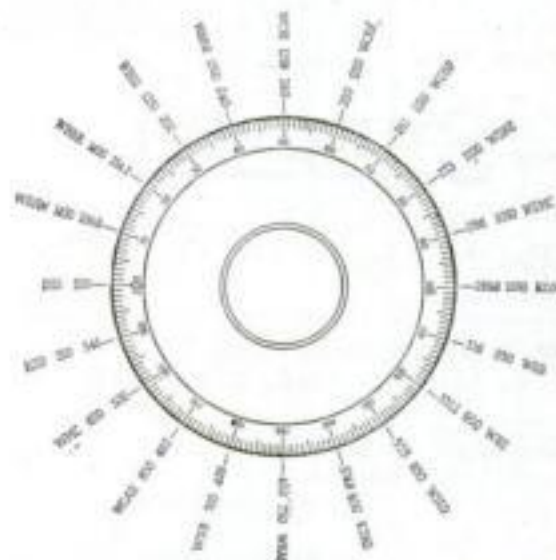
Stations indicated in kilocycles and wavelengths showing crowding with an ordinary capacity condenser.



Stations partially separated and tuning slightly improved with a Straight Line Wave Length Condenser.



Practically even separation over half the dial with a Straight Line Frequency Condenser.



Complete and equal separation of stations over the entire dial with the Rathbun Straight Line Frequency Converter.



If You Are Particular About Your Car . . .

If you want to keep it running like new for a long, long time, don't wait for serious trouble. You can buy a little set of Snap-On Wrenches for a small sum that is designed especially for work on your car alone and it will make it so astonishingly easy for you to keep all the nuts and bolts properly tightened up that you will never let your car get badly out of fix. With your Snap-On Set you can prevent road trouble and save the time and expense of being towed in. Use genuine Snap-Ons like the experts use. Look for the name Snap-On on each handle and socket. It is not a genuine Snap-On without the name.

Snap-on
INTERCHANGEABLE
Socket Wrenches
SNAP-ON WRENCH CO., MFRS.
Milwaukee, Wisconsin

Motor Tool Specialty Co.,
14 E. Jackson Blvd., CHICAGO

Gentlemen:

Please send particulars about Snap-On Set for . . . car. (If interested in Master Mechanic's Set, check here . . .)
I buy tools from . . .
Name . . .
Address . . .

The Home Workshop

Profitable Job Contest

(Continued from page 118)

illustrated in it and have sold some of them.

The most profitable one was a kitchen cabinet, built from your Blueprint No. 5. I did not follow your directions exactly, but got the main idea from the blueprint. A cabinet like the one I made costs about \$65 to buy; it cost me for material \$25.53, so that I figure I saved at least \$35 by making the cabinet myself. In addition I made a second cabinet and sold it at \$25 profit, making me a profit of \$60 on the two cabinets.

It took me a month to make the last cabinet, working at it only in the evenings after six o'clock. The tools used were hammer, saw, square, and a large and small plane. The dimensions were 71 by 48 by 26½ in. The cost was as follows: Glass knobs, \$1.20; wood screws, 60 cts.; 2 qts. paint, \$1.90; 2 qts. enamel, \$2.40; corner braces, 30 cts.; latch, 20 cts.; elbow catch, 6 cts.; sandpaper, 25 cts.; hinges, 46 cts.; blacksmith, 50 cts.; oilcloth, 60 cts.; nails, 25 cts.; express, \$1.99; postage, 24 cts.; lumber, \$9.50; flourbin, \$2.80; glass, 60 cts.; glides, 10 cts.; lock, 25 cts.

THE entries in this contest revealed an almost incredible range of home workshop activities. The tabulated list of projects ranges all the way from awnings, bathtubs and beds, to tea wagons, trellises and wells.

Ratproof Pigeon Perch



IN PREVENTING the disheartening destruction of pigeons by rats, the perch illustrated above has proved effective. It is simply a wooden pole or broom handle suspended in midair by wire. Braces of fine wire are used at each end to prevent the perch from swinging.—C. M. WILCOX.

Pipe Wrench Used as Vise

FEW things are more awkward than to have to do any work with pipe when no vise is at hand. In such an emergency, a pipe-vise may be improvised by nailing or clamping a pipe wrench of the steel handle type on the workbench or any convenient place.

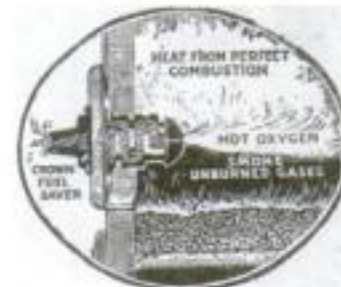
In one instance a heavy pipe wrench was bolted to a repair truck.



Stop Wasting Coal!

Use less coal—get more heat—haul fewer ashes—stop extra trips to "fire up"—have your home warm and balmy—**SAVE MONEY** by stopping your fuel dollars from going up the flue. Make your heating plant **MORE EFFICIENT** with the

CROWN Fuel Saver



A scientific device, easily installed on furnace door, which mixes a supply of super-heated air (oxygen) with the gases over the fuel bed.

Utilizes many heat units which would otherwise be drawn up the flue. Brings the fire to the top of the bed of coals, where it does the most good. Warranted to save 20% of coal bill—often saves much more. Successfully used for 10 years.

Write for Description

A detailed description of the CROWN—its scientific principle—application—and splendid results—has just been issued. Write for it, especially if you buy coal for home, school, theatre, church or greenhouse. You can use cheaper low grade fuels with great success.

Distributors Wanted A wonderful sales proposition and exclusive territory for a few more live distributors. **WRITE TODAY**—ask if your locality is open.

CROWN FUEL SAVER CO.

110 N. Tenth St., Richmond, Ind.



Daytime System—Nighttime protection for your tools provided by **Gerstner Tool Cases** for **MACHINISTS** and **TOOLMAKERS**. Write for Free Catalog. **H. GERSTNER & SONS** 522 Columbia St., Dayton, O.

1926 CATALOG JUST OUT!

SEND FOR YOUR COPY
RANDOLPH RADIO CORP.
159 N. UNION AV. Dept. 3 CHICAGO, ILL.

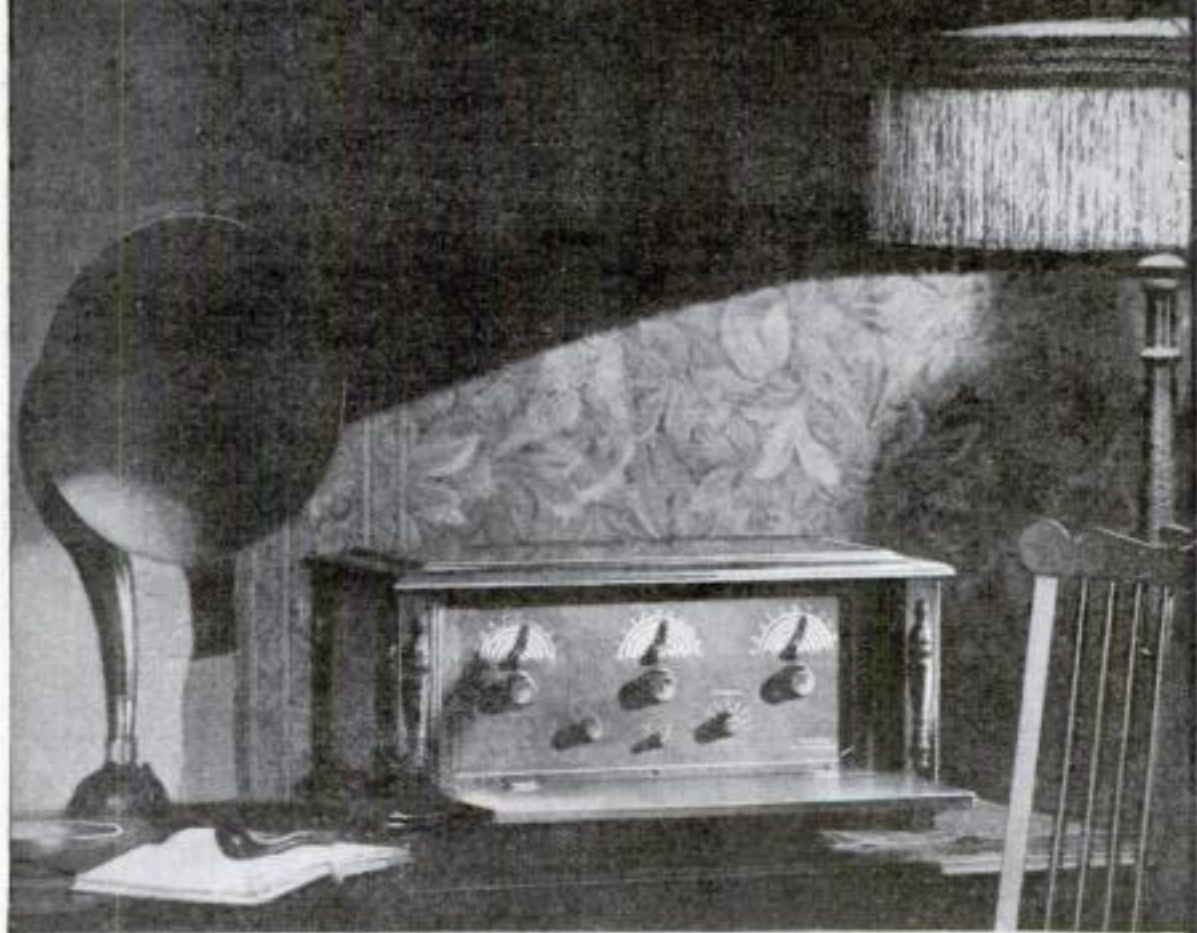
"LIGHTING FIXTURES"
Ready to hang.
Direct from the manufacturer.
Completely wired including glassware.
Send for New Catalogue No. 27 (Just reduced prices).
Special proposition to Dealers
ERIE FIXTURE SUPPLY CO.
Desk A, Erie, Pa.

NEEDED EVERY OFFICE
DUPLICOPY
EASY TO OPERATE—NEAT AND FAST
DUPLICATES anything typewritten, handwritten, drawn or typed, 60 copies per minute! Thousands from ONE original! New self inking models AUTOMATICALLY FEED AND SPREAD THE INK. Three sizes: Postcard \$9.00; Note \$13.00; Letter \$17.00. Write TODAY for samples of the work and Five Day Free Trial Offer.
DUPLICOPY Mfg. Co., 626 Jones St., San Francisco, Cal.

DAVID Grimes

SUPER-SELECTIVE

RADIO



David Grimes
Super-Tone
LOUD SPEAKER
with a mica diaphragm
that eliminates
distortion . . . **\$25**



ITALIAN RENAISSANCE MODEL
Utilizing 4 tubes with the efficiency of 6
tubes. Built in a Renaissance Cabinet of
two-tone Mahogany and Wal-
nut concealing all batteries. **\$125**
(Without Accessories)

Ask a Grimes Dealer for Demonstration

More Stations On the Air

YOU'LL want to hear them all—
but one at a time. The Grimes
Circuit in the Grimes Inverse Du-
plex receiver will give you the sharp
tuning desired. Greater volume, dis-
tance range and a tonal quality
you've never heard before are also
yours in this remarkable instrument.

Dual operation of the tubes, pro-
viding two stages of radio frequency,
vacuum tube detector and three stages
of audio frequency amplification,
gives you the energy of a six tube
set with the economy of four tubes. A
super power switch gives tremendous
reserve power for distant stations.

A new form of inductance—the twin
cylinder coils and straight line con-
densers allows you to tune in the de-
sired programs and shut out the rest.



BABY GRAND Duplex Model,
using 3 tubes with the power of
4 tubes. In two-tone mahogany
cabinet, housing all batteries.
(Without Accessories) **\$49.50**
West of Mississippi \$60



EMPIRE MODEL, in reality a 6
tube set operating on 4 tubes.
Enclosed in 17th Century Solid
Mahogany French Cabinet, hous-
ing all batteries. **\$125**
(Without Accessories)

Products of
**David Grimes Radio
& Cameo Record
Corporation**
1571 Broadway, New York, N.Y.

The Home Workshop

Sewing-Machine Cabinet Built into Wall

By A. May Holaday

IN THE modern space-saving apartment the old-fashioned sewing-machine has been supplanted by the small electric portable. A convenient place for the electric sewing-machine is seen in this sewing-cabinet set into the wall close to a window.

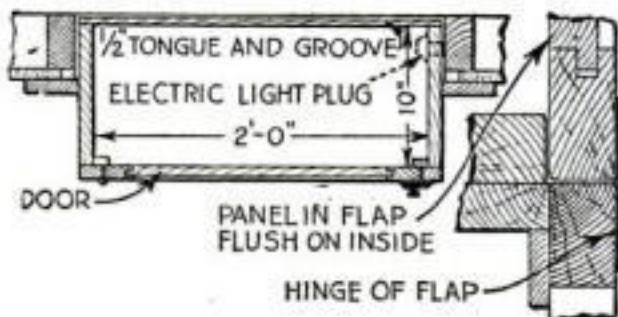
The opening, which is cased all around and provided with two small doors, may be of any desired height and fitted with shelves to suit one's needs. But the shelf holding the electric machine should be set 29 or 30 in. above the floor.

The upper door is a drop-leaf that opens downward to shelf level; it is supported by hinges and two strong chains. The machine is drawn forward



on this handy table and the cord is plugged into an electric outlet inside the cabinet. A dining-room chair is of proper height to use with this table.

Any narrow wall cabinet or china cupboard already built in the house, if 10 in. deep and 2 ft. or more wide, may be converted into a similar sewing-cabinet.



Horizontal section through the cabinet, and detail showing the framing and door construction

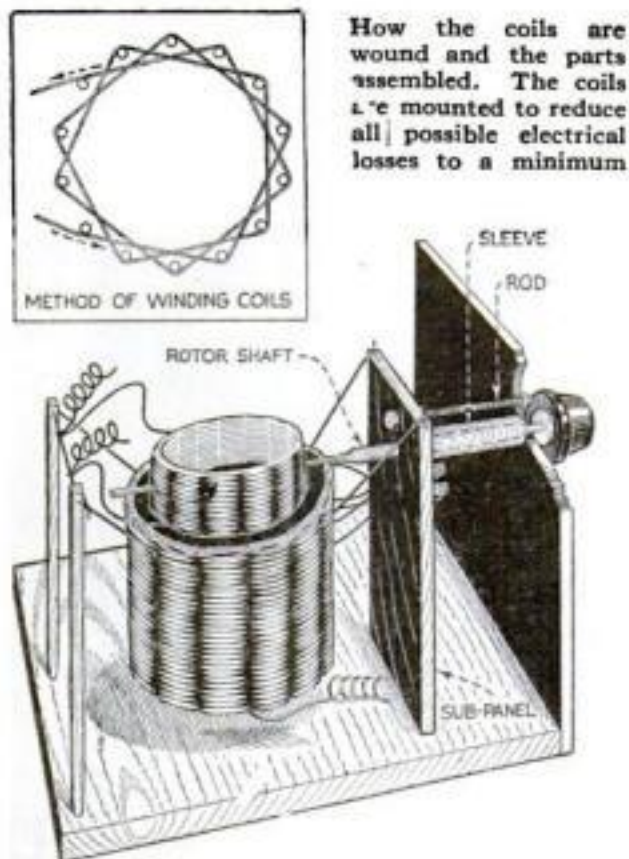
A Variocoupler of Exceptional Efficiency

AT SLIGHT expense any one can make an unusually efficient variocoupler for a radio receiving set. The only outlay will be for a spool of No. 18 double cotton-covered magnet wire for

or rotor coil is $2\frac{1}{2}$ in. in diameter and has 40 turns. The turns are bound together with thread, making the coils practically self-supporting.

The rotor shaft, sleeve, and subpanel are wood, although hard rubber or other insulating compositions may be used, if preferred. Holes are drilled in both panels to allow the passage of the shaft. The sleeve is slipped over the rotor shaft and fastened to it with a brad. A threaded rod fastened with a nut at each end is used to draw the subpanel toward the main panel. The proper tension on the rotor shaft is obtained by tightening one of these nuts. The subpanel also is fastened to the base of the set with brads. A knob or dial is fitted to the shaft.

The primary coil is suspended beneath the secondary rotor by strings that are attached to the subpanel and to two supporting posts.—E. L. GOODWIN.



How the coils are wound and the parts assembled. The coils are mounted to reduce all possible electrical losses to a minimum

winding the coil, as the other materials usually are to be found about the house.

Winding forms are made by drilling holes in a board and setting pegs as shown. The primary or stationary coil is 4 in. in diameter and has 80 turns tapped at every 20 turns. The secondary

Toy Dresser Made from Box

THE dresser illustrated, which is 11 by 16 by 23 in., was built from wood taken from an old box and a small mirror. It was given three coats of white paint and one of ivory enamel.—ALBERT HOBBERG.



A doll's dresser that cost little

"ATKINS"

Always Means Quicker, Easier Metal Cutting!

YOU—whenever and wherever you cut metal—can save time and money by using genuine Atkins "Tungsten Alloy" Hack Saw Blades.

The Atkins Hack Saw Chart—free—tells the right Atkins blade for every metal cutting job, to save you time, money and material.

The name ATKINS on the blade means the highest grade "Tungsten Alloy" steels, chosen by the great Atkins laboratories, tempered by the exclusive Atkins gas and oil process, "file tested" to prevent breakage and insure extra life and value.

Ask YOUR Hardware Dealer for genuine ATKINS "Tungsten Alloy AAA" Hack Saw Blades. "All Hard" or "Non-Breakable." We'll gladly send you the Atkins Hack Saw Chart and our valuable booklet "Atkins Saws In The Shop."

E. C. ATKINS & CO.

Established 1857

Leading Manufacturers of Saws, Saw Tools, Saw Specialties and Machine Knives.

INDIANAPOLIS, U. S. A.

ATKINS
TUNGSTEN
ALLOY SAWS

The Home Workshop

How to Cover Cracked Plaster

(Continued from page 71)

in using only the regular studs already in place, but it certainly is worth while to cut away the plaster and lath for inserting an extra stud where a well formed panel cannot otherwise be obtained.

Having decided the plan of panels on the ceiling and taking into account the width of the decorative strips, strike guiding chalk lines and nail across the joists 1 by 3 in. furring strips (Fig. 1). Preferably these should not be more than 16 in. apart from center to center. Border the edges with 1 by 4 in. strips. With a straight edge try these for alignment with themselves and the rest, driving shingle points under the low places to bring them to a line.

THE wallboard may be cut easily with a fine saw, or by scoring with a knife and breaking off. If one person must put it up alone, make a T support to hold up one end.

Patent clinching fasteners for the fiber boards are to be recommended for use on intermediate furring strips, as they eliminate nail holes in the centers of the panels. If these are not used, nail the centers every 8 in. with 1-in. No. 16 brads, driving the heads nearly flush and countersinking with a nail set. Then nail the edges with No. 16 1 or 1 1/4 in. flat-head nails 10 in. apart, keeping at least 1/2 in. from the edges. Leave a 3/16-in. space between the boards.

If the wall plaster is reasonably straight, apply the board directly, but if it is crooked, nail 1 by 3 in. furring strips to the studding. In either case remove the picture mold, and if furring is used, take up the baseboard as well. This may be used again if pried off carefully. Pull the nails from the back with pliers or cut them off flush rather than pull them from the face; in this way nail holes and probable splintering are avoided. Take off any plate and chair rails, but do not remove the side or head casings of doors and windows. Since the joints between the window aprons and the stools are hidden, it is well to pull off the aprons also. Notch out the back edges of the projecting stool ends, as in Fig. 5, to allow the board to be slipped in behind.

Where no furring is used, locate the studs by tapping the plaster with a hammer, and mark their positions. Stand the board on the base and nail the top with four 2-in. flat-head nails. Strike a white chalk line for the studding and nail the centers with sixpenny finishing nails. Use flat-head nails at the edges, except where they butt against the casings. Fit snugly around all casings.

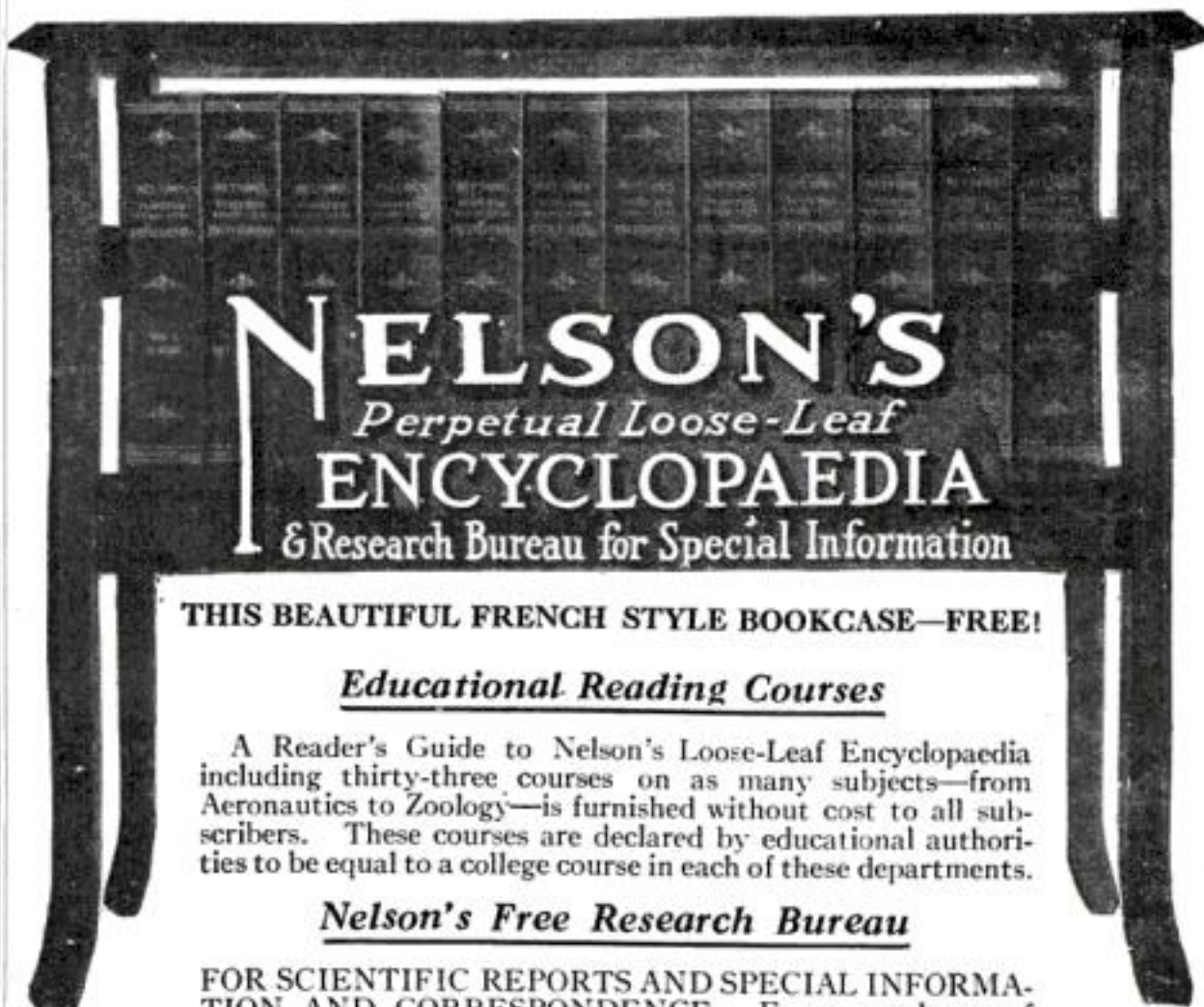
For the average room, decorative strips 2 1/2 in. wide (stuck from stock 3 in. wide) and 1/2 in. thick are satisfactory. The profiles detailed in Fig. 6 are neat, the third design being the best, though somewhat the hardest to handle. If the plain profile with the rounded corners is used, most of the joints with the cornice and base may be butted. If the edges are

(Continued on page 124)

Man's Education never Ceases

Education is the process of conquering one's environment. The widening of this circle ends only with life. Every day the world should be made new by some new acquisition of truth. Huxley says—"All education is habit formation." Those who form the Encyclopaedia habit—a few minutes a day with Nelson's—are the educated and progressive men of their day.

JOHN H. FINLEY,
Editor-in-Chief.



THIS BEAUTIFUL FRENCH STYLE BOOKCASE—FREE!

Educational Reading Courses

A Reader's Guide to Nelson's Loose-Leaf Encyclopaedia including thirty-three courses on as many subjects—from Aeronautics to Zoology—is furnished without cost to all subscribers. These courses are declared by educational authorities to be equal to a college course in each of these departments.

Nelson's Free Research Bureau

FOR SCIENTIFIC REPORTS AND SPECIAL INFORMATION AND CORRESPONDENCE. Every purchaser of Nelson's is entitled to free membership in this Bureau. If at any time you are in doubt on any subject, old or new, write to this Bureau with the positive assurance that you will promptly receive the latest obtainable and most dependable information.

THE GREAT AMERICAN ENCYCLOPAEDIA

NELSON'S PERPETUAL LOOSE-LEAF ENCYCLOPAEDIA—the Great American Reference Work—is published by one of the oldest and largest International Publishing Houses. The Editor-in-Chief is John H. Finley, LL.D., L.H.D., Editor, New York Times; the Canadian Editor is Sir Robert Falconer, K.C.M.G., D.Litt., LL.D., President of the University of Toronto; the European Editor is Sir Henry Newbolt. Its staff of contributors includes men and women foremost in scientific, professional and public life, who are themselves making history.

This Great American Encyclopaedia

is always an authority in government departments, libraries, schools and educational institutions everywhere. It covers every field of knowledge, from the beginning of the world to the very latest activities of the present day; by means of the Loose-Leaf binding device, it is the only Encyclopaedia always up to date—it cannot grow old—it is always dependable.

Originators of the Loose-Leaf Reference System

EXCHANGE Send for price list giving amounts allowed for old Encyclopaedias to apply as part payment on a new Nelson's Perpetual Loose-Leaf Encyclopaedia.

THOMAS NELSON & SONS

Publishers for 125 years

P. S. 10, 381 Fourth Avenue, New York City

Please send me your portfolio of sample pages, beautifully illustrated, containing color maps, plates and photographs, and full information how, by easy monthly payments, I can own Nelson's Perpetual Loose-Leaf Encyclopaedia and receive FREE bookcase and membership in Nelson's Research Service Bureau for Special Information. This must incur no obligation whatever on my part.

Name.....

Address.....

City..... State.....

(Adv. Copyright, 1925, Thomas Nelson & Sons)

The Home Workshop

How to Cover Cracked Plaster

(Continued from page 123)

molded, joints with the cornice must be made by mitering in the depth of the molded edge and butting the plain width (Fig. 8). Many mills will run special moldings on the strips for a small additional cost for setting up the machine. It is common practice in some sections of the country to use plain panel strips and separate panel moldings, which can be obtained in various styles.

The ceiling member of the cornice, it will be noted, is $\frac{1}{2}$ in. wider than the lower wall member, so that the same width will be shown by both pieces when they are in place. Always use, if possible, such widths as will cut without waste from stock sizes.

Put up the ceiling member first, either mitering the corners complete (Fig. 1), or mitering the molded edges and butting the widths as previously explained. Cut the strips to length, measuring them individually for the places they occupy, and mitering back the edges. Tack one end in place while the miters are scribed on the cornice. Then take down and cut out the miters with a chisel, cutting inside the line and trimming straight the butted portions, acting on the assumption that it is easier to cut out a little more wood in fitting than to add to it.

IF THE strips are cut a trifle long, and the ends placed with the centers bowed down, the leverage developed in straightening the piece will go far to close irregularities in the joints. Be very careful, however, to keep these strips straight, and to avoid such pressure in any one that joints in others already nailed up will be opened. Scrape and sandpaper the joints.

Next, run the wall member of the cornice. Butt the upper edge of this member against the ceiling piece, first beveling the edge back from the face to insure a close fit. Put up the two long sides and cope the end pieces between, also springing them into place.

The joints between wallboard and casings now must be hidden. Figure 6 shows desirable forms of back band to run around the casings, but the thickness will vary in each case, according to the thickness of the wallboard.

If the casings are molded and mitered, as in Fig. 3, simply miter the back band around them; but if the ordinary butted casing with neck and cap mold is used, as in Fig. 4, other handling is necessary. Remove the cap mold before applying the wallboard, cut off the projecting ends of the neck mold, and notch the front edge to fit against the lip of the back band. Then miter the band around, and replace the aprons under the windows.

Next, apply the panel mold for the base (Fig. 7), and cut the decorative strips between it and the cornice.

The corner strips are molded on one edge only, one piece being $\frac{1}{2}$ in. wider than its mate, so that when butted together on the edge as shown, they will expose equal widths.

(Continued on page 125)

Renew-restore this quick and modern way

NOW there is a quick and easy way to transform cracked walls and ceilings anywhere. Upsonize!

Have your carpenter apply the sturdy, room-high panels of Upson Board right over the old plaster. Write us for a simple plan. Then paint—apply wood moldings, and—

Your room is finished! Little dust or muss, no irritating delay! Upson Fasteners eliminate disfiguring nail-marks.

Properly applied, Upsonized walls and ceilings lie flat—they should never warp or buckle.

UPSON BOARD

Write for detail
blue print



UPSON products are handled by reliable lumber and building material dealers everywhere. Ask the one nearest you, or write The Upson Company, 1027 Upson Point, Lockport, N. Y., describing type of room you are remodeling, and enclosing ten cents for detail blue print.

Look for the famous blue center

INGERSOLL DOLLAR STROPPER

Robert H. Ingersoll, originator of the famous Ingersoll Watch, offers you his remarkable new invention that brings back keenness to used blades, makes them last longer and give clean, smooth, comfortable shaves. Already satisfying thousands.

Hundreds of Shaves
From Every Blade

The INGERSOLL DOLLAR STROPPER makes it possible to keep razor blades good for a whole year — HUNDREDS OF SHAVES FROM EVERY BLADE! That means no more discarding blades after a few shaves. Re-sharpen them, and SAVE \$5 to \$10 a year.



10 Days' Trial
Prove that the Ingersoll Stropper is all we claim. Send \$1.00 for outfit complete with 12-inch Strop and Patent Nick at-Pointed Holder. Automatically puts scientifically keen edge on blades! Money back guaranteed if ten day trial doesn't convince that Mr. Ingersoll's new invention solves your razor blade troubles. Write today, mentioning make of razor used.

Agents: Write for Proposition.

ROBERT H. INGERSOLL, Pres., New Era Mfg. Co.
Dept. 7810, 476 Broadway, New York City

CARTER New "IMP" Rheostat

(Pat. Pend.)

\$1.00

Half
Size



6 ohms
and
25 ohms

Smallest rheostat made. Diameter $1\frac{1}{4}$ inches. Projects but $\frac{1}{4}$ inch back of panel. Single hole mounting. Complete with pointer knob. New exclusive Carter method of contact. Positive, smooth, silent. Same Carter high quality and standard of workmanship. See one at your dealers today. Write for information on other Carter original Radio products.

Any dealer can supply.

In Canada—Carter Radio Co., Ltd., Toronto

Carter Radio Co.
100 S. MICHIGAN AVENUE
CHICAGO, ILL. U.S.A.

The Home Workshop

Short Cabinet Clamps Used for Holding Long Work

WHEN about to glue up a long buffet, I found my cabinetmaker's iron clamps were much too short. I therefore made three strongly mortised hardwood frames $\frac{1}{4}$ in. wider than the buffet and about 3 in. longer, and cut 12 wedges $2\frac{1}{2}$ in. wide, ta-



Gluing up a large buffet

pering from $\frac{1}{2}$ to 2 in., as shown in the illustration above.

After the buffet joints had been glued, the frames were placed as shown and supported by the pieces A. The wedges B were inserted as indicated and spacing boards C were placed so as to exert pressure on the wedges of the middle frame. The clamps then were used to squeeze the wedges together and draw the joints tight.—I. H. C.

How to Cover Cracked Plaster

(Continued from page 124)

If it is necessary to fur the walls, use 1 by 3 in. stock and then apply the board in the same manner as on the plaster. It will be seen that the board projects its thickness outside the ordinary casing. This necessitates the use of a panel mold to cover the joint and the lip in this case clasps over the wallboard instead of the casing. If judgment is used in this, all bungling massiveness in appearance can be avoided.

In the case of a brick or tile house, the walls must be drilled and plugged with wooden cylinders $\frac{3}{4}$ in. in diameter and $1\frac{1}{2}$ in. long, to provide nailing for the furring strips. To prevent entrance of moisture, waterproof the walls with asphaltum or some other suitable protective paint.

Fill nail holes with white lead putty made by mixing whiting and white lead in oil, or whiting and the sediment found in paint cans. The panels are best painted with flat colors, except in kitchens or other rooms subjected to moisture. Mix with the first coat one-third of hard drying varnish, or, if the panels are to be papered, give them a priming coat to facilitate removal of paper in later decorating jobs.

Paint or stain the decorative strips very nearly, if not exactly, the same tint as the panels, getting color contrasts through the use of draperies.

Other applications of wallboard will be described in an article, "Home Beautifying with Wallboard," which will be published in an early issue.



It makes life's writing easier~

FOR every age and every station—for men, women, and children—the New Remington Portable is an invaluable helper.

For the *child* it is an inspiration which facilitates composition and hastens the writing age.

For the *student* it saves valuable time for athletics and other school activities. Then too, typewritten work brings better marks, and correspondence has no burdens.

For the *traveler* it has extreme lightness; for the *professional man* it combines every advantage; and for all it is a time-saving convenience, possessing in compact form all the writing merits of a larger machine.

Our NEW model has several mechanical improvements that give it an efficiency never before equaled in a portable typewriter.

It is the lightest and most portable Portable with 4-row standard keyboard; it is the most compact Portable; it has the longest writing line of any Portable; it accommodates full width paper and long envelopes; it has the finest touch and action; it does beautiful work; its durability has been proved; and *all* the writing is *always* visible.

Be sure to examine the New Remington Portable, or write for our illustrated "For You—For Everybody." Address Department 67.

REMINGTON TYPEWRITER COMPANY
374 Broadway, New York—Branches Everywhere

Remington Typewriter Company of Canada, Limited
68 King Street, West, Toronto

Remington Portable

We believe we make the best typewriter
ribbon in the world—and its name is
PARAGON



The New Model Now Available

The New Remington Portable is sold by Remington offices and dealers everywhere. It is backed by a service that is universal.



U. & U. Photo

The illustration pictures the take-off of the winning flight and in the insert is the radio equipment carried. (Burgess 'A', 'B' and 'C' Batteries furnished the electrical energy to operate the set.)

When the Goodyear III won the right to represent the United States at Belgium, Burgess Radio Batteries supplied the electrical energy for the operation of the balloon's radio equipment.

Almost every day from somewhere in the world news comes to us of new Burgess adventures.

And that Burgess Batteries have contributed their bit in so many interesting events of sport, commerce and science reflects the esteem in which they are held.

"Ask Any Radio Engineer"

Your own radio dealer down the street sells Burgess Batteries. He probably sells the famous Burgess Flashlights, too.

BURGESS BATTERY COMPANY

GENERAL SALES OFFICE: CHICAGO

Canadian Factories and Offices:
Niagara Falls and Winnipeg



The Home Workshop

Fitting Up an Attic Room

(Continued from page 76)

wedging the jambs) and 6 ft. 7½ in. high (allowing for a 6 ft. 6 in. door with ¼ in. to spare for leveling the head jamb). If possible, use a regular stud for a side trimmer; but in any event, since the space above is so short, run the trimmer to the ceiling. The door, it will be noted, is located by the hall opening.

Start spacing the studs from the other trimmer or, if the space is small, divide evenly, as shown. This, of course, is not regulation procedure in the case of an ordinary partition of full height; but it is best for such a case as this, particularly when wallboard is to be used. Spike into the head trimmer from the side trimmer with two or three 16-penny common nails, being careful to keep it level. On the backs of the side trimmers nail three blocks to catch the back edges of the door casings, and put blocks at the corners of the room to insure nailing for the baseboard ends.

THE other end of the room is built in about the same way, while for the end of the closet the gable studs are used, if such are present.

Figure 7 illustrates the side wall. This is nailed together on the floor and raised afterward, but careful vertical measurements should be made to make certain that, when the upper plate is brought against the under edges of the rafters, the wall will come plumb.

Above the upper plate a space of 3 in. remains, and if the room is to be plastered, blocks must be fitted between the plate above the studs and against headers of 1 by 4 in. boards cut between the rafters, as in Fig. 5. For wallboard, nail in the headers flush with the under edges of the rafters and let them show 2 or 3 in. above the point of intersection of the wall. Fill the space above the plate with a 1 by 4 on edge and notched about the rafters (Fig. 6).

Between the studs of the end walls, following the slope of the rafters, nail pieces of 2 by 4 as backing for the upper edges of the wallboard, as in Fig. 2, and 3½ ft. from the floor cut in fire blocks for additional stiffening. Wherever corners occur, backing must be provided to carry the edges of the wallboard.

Side walls and sometimes end walls should be braced by cutting 2 by 4 in. blocks between studding, as in Fig. 7.

Ceiling joists are placed level at each end wall, the ends butting against the under edges of the false rafters. The others are spiked to the sides of the rafters, and must line with each other. If a straight-edge is nailed to the ends of the end joists, the others can be rested on them and nailed up without further trouble. Bring the rafters to a line if they are of uneven width, by shimming carefully under the narrow ones with thin strips of pine.—E. M. L.

How to continue from this point will be told in the third article of the series in next month's POPULAR SCIENCE MONTHLY.



Save \$44.00 on this Beautiful White Enameled Kitchen Cabinet

THIS handsome white-enameled kitchen cabinet would cost \$65 if bought in a store. If you are handy with tools you can make it at home for \$21—or less. A clear saving of \$44.

One feature of this cabinet is a self-contained seat. Another attractive feature is the roomy china closet occupying the middle section of the top of the cabinet.

Besides the china cupboard, the top section contains a flour-bin and a closet for sugar, spices, and coffee. The bottom section has one large cupboard and three drawers, the lower one being a metal-lined bread and cake container. There are two large boards that pull out.

A blueprint with a bill of material and instructions for making this beautiful cabinet can be secured by sending 25c to

POPULAR SCIENCE MONTHLY,
250 Fourth Avenue, New York

POPULAR SCIENCE MONTHLY
250 Fourth Avenue, New York

Gentlemen:

Enclosed is 25c for which please send me blueprint for the Popular Science Kitchen Cabinet including all the latest features—

Name

Address

City

State



Home Workshop Chemistry

*Simple Formulas that
Will Save Time
and Money*

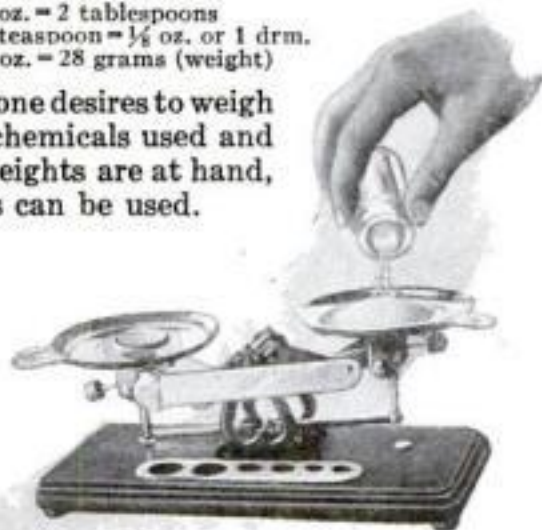
TEA SPOONS and other common household units of measuring are used in the Home Workshop Chemistry column whenever possible to simplify the making up of formulas. Judging from letters received from readers, the mere mention of grams and cubic centimeters makes a formula seem complicated. Yet it is a simple matter to convert one measure into another with sufficient accuracy for ordinary purposes.

The proportions are what count in making up a formula. For instance, if ounces are given, the process need not be carried out in ounces; any convenient unit of measurement may be used. The only thing to be considered is that the quantities are reduced or increased in the same proportion throughout.

Here is a table of useful equivalents:

1 oz. = 2 tablespoons
1 teaspoon = $\frac{1}{2}$ oz. or 1 dr.
1 oz. = 28 grams (weight)

If one desires to weigh the chemicals used and no weights are at hand, coins can be used.



Using coins in place of chemist's weights

A half-dollar = $12\frac{1}{2}$ grams
A quarter = $6\frac{1}{2}$ grams
A dime = $2\frac{1}{2}$ grams

In avoirdupois:

A half-dollar = 200 grains A cent = 50 grains
A quarter = 100 grains A dime = 40 grains
A nickel = 80 grains 1 oz. = 437 $\frac{1}{2}$ grains
Therefore, 2 half-dollars (400 grains) and a dime (40 grains) combined are near enough to serve as a 1-oz. weight

If your scales are without a scale bar and it is desired to obtain a weight of, say, 30 grains, place a nickel (80 grs.) in one pan and a penny in the other. Then add the chemical or whatever is to be weighed to the pan holding the cent until a balance is obtained. Any number of combinations can be used in this manner to find intermediate weights.

For average purposes:

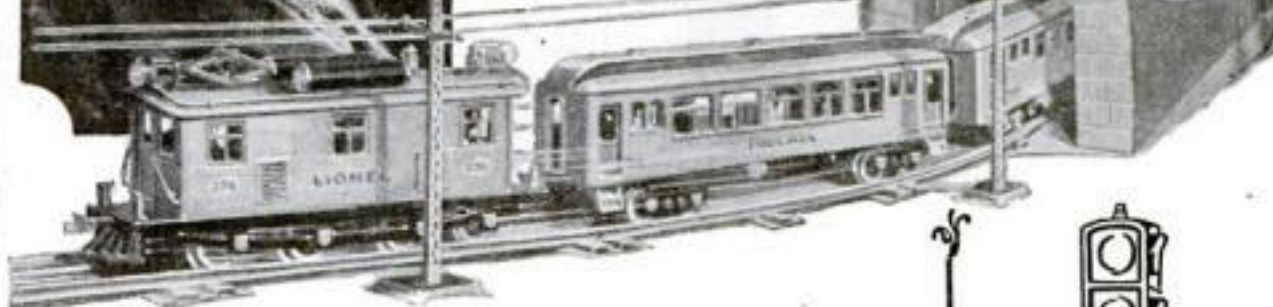
450 drops = 1 oz. or 30 cubic centimeters
1 large water-glass holds about 6 fluid oz.
1 pt. water = 1 lb.

Many almanacs and general handbooks contain tables showing the comparison between the Centigrade and Fahrenheit scales and these can be consulted on the relatively few occasions a question arises.

When it is necessary to convert metric measurements of length into feet and inches, either purchase a rule that has both scales or consult the tables in any general handbook.



James J. Hill, one of America's greatest railroad pioneers. Some boy who, today, is acquiring his electrical and mechanical knowledge with Lionel Model Railroads may be the James J. Hill of the future.



LIONEL TRAINS are Models— not mere "Toys"

IN appearance and in operation Lionel Model Trains are just like real railroads. There is a thrill in operating them that you cannot get from any mere "toy" train. The only difference between Lionel Model Trains and real trains is the size.

Lionel Model Trains and Railroad Accessories are designed from real railroad equipment by Lionel engineers for boys who want things exactly as they should be.

For twenty-five years Lionel Model Railroads, Multivolt Transformers, and Model Railroad Accessories have held their leadership.

They have kept pace, year by year, with the improvements and developments of real railroads. They are up-to-the-minute and are the lowest priced consistent with quality.

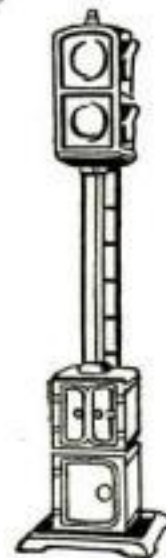
Take Mother and Father with you to see the latest Lionel Locomotives, Coaches and Accessories—on display at all the best stores. There is a Lionel Outfit priced to suit every purse—complete outfits from \$5.75 up.

THE LIONEL CORPORATION

Dept. B, 48-52 East 21st Street, New York City



Write today for this beautiful new 44-page catalog, illustrated in actual colors. Sent free.



Lionel Automatic Train Control. The greatest achievement in model railroad engineering. Starts and stops trains automatically. Just one of the many wonderful realistic railroad devices in the Lionel line of Accessories.



The Lionel Bell Warning Signal—As the train approaches the grade crossing, bell automatically rings—stops ringing as soon as train has passed. Steel construction throughout.



Lionel "Multivolt" Transformers. Ever-reliable power plants. Run all trains best. A type for every size train.

LOOK
FOR THE
PATENTED
LIONEL
FEATURES

LIONEL ELECTRIC TRAINS

MODEL RAILROAD ACCESSORIES

"MULTIVOLT" TRANSFORMERS



Pat Schaefer Heats Homes With AMAZING NEW LIQUID GAS

Now—right in your stove, you can have the convenience of automatic heat—any degree—by simply turning a valve. Cheaper, cleaner, drudgery saving. So remarkable has been the success of this new invention that Pat Schaefer guarantees to heat your home this new, easy way on thirty days' trial—and you pay nothing if you do not get perfect heating or cooking satisfaction.

Do you want to end forever the soot, ashes, dust and drudgery of dirty coal and wood—the worry of strikes and shortages, poor quality and high prices? Would you accept an opportunity to try out in your home on thirty days' trial a wonderful new invention which does all that—and gives you more dependable heat besides?



Fits any heating stove, range or furnace.

Fits All Stoves Without Change

Never has such an extraordinary offer been made! Why? Because at last, an oil burner has been perfected which has revolutionized the industry. A small quantity of kerosene (coal oil) will heat your home for hours—you get any degree of heat by simply turning a valve. And any stove, heater, or furnace can be equipped without drilling holes or any other change. Installed in a few minutes, then perfect heat to suit any day—mild or zero weather.

Thirty Days' Trial— Mail Coupon

Pat Schaefer will send this marvelous invention to you on thirty days' trial. You do not have to pay a cent for it if it does not do everything he claims for it. Be ready for Winter. Save buying coal. Send the coupon at once to



Instant heat, any degree at turn of valves.

AGENTS

Spare time workers, full time workers, write quick for details of this amazing fast seller. More than \$250,000 commissions already paid out to agents. One man made more than \$200 in one day. Free Territory, Cash Bonus, and Sample Case Offer. Producers send name and address to Pat Schaefer, President. Simply ask him for selling plan.

OLIVER OIL BURNER CORPORATION
Dept. M-343 7th and Market Sts. St. Louis, Mo.

OLIVER OIL BURNER CORPORATION

Dept. M-343 7th and Market Sts., St. Louis, Mo.

Please send me at once your booklet, full details of your low price and free trial offer. I am interested in a burner for ☐ Cook Stove ☐ Heater ☐ Furnace

Name.....

Address..... County.....

City..... State.....

The Shipshape Home

Sawhorse Aids in Repair Work

MANY house-owners endeavor to make the various repairs necessary in keeping their homes shipshape without the aid of a good sawhorse. Yet a sawhorse is as essential for odd jobs as a bench is for cabinetwork. It can be carried wherever needed and used both as a support for work that is to be sawed, planed, chiseled, assembled, or painted, and as a platform on which to stand. For repairs that involve the handling of long boards, doors, full sized window-screens, storm sash and doors, and the like, a pair of sawhorses is desirable.

There are, of course, several types of wooden sawhorses. While few carpenters and, I suppose, fewer amateur woodworkers, are familiar with the design illustrated, it is much better than the

A sawhorse that gives good service for odd jobs



average sawhorse. Every carpenter who has used mine, thereafter has made his own sawhorses like it.

This horse has a double top made of 2 by 4's separated 1 3/4 in. by spreaders. This affords a solid stand for ripping boards. The recesses at each end allow doors or sash to be placed in them for trimming. The wide top gives more foot room when one has to stand on the horse.

The bottoms of the legs, furthermore, are exactly 4 ft. apart lengthwise and 16 in. apart crosswise. The advantage of this, from the viewpoint of a carpenter working on new construction, is that the sawhorse can be placed either way on ordinary joists set 16 in. center to center.

To make the horse requires 2 pieces 2 by 4 by 48 in. for the top; 2 pieces of 2 by 4, 3 3/4 in. long, to serve as the spreaders; 4 pieces 3/4 by 4 1/2 by 26 in., tapered to 2 1/2 in. wide at the bottom, for legs; and 2 end braces, 3/4 by 7 1/2 by 12 in. Any common wood will do, but the parts should be sound, especially the legs.

(Continued on page 129)



Elto

(Designed and built by Ole Evinrude)
**Quick Detachable
Rowboat Motor**
Powerful, Light Weight, Speedy, Quiet Running, Practically Vibrationless. Starts on a quarter turn. Easily carried with you anywhere you go. No rowing, no work, no bother. Just ride and enjoy the greatest of water sports. Slow down for fishing. Speed up for racing. Great power.

Write for FREE Catalog describing all the new features, especially the famous Propeller Pump. Only Elto has it. Write today.

ELTO OUTBOARD MOTOR CO. Dept. W
The Evinrude, Pres.
Manufacturers Home Bldg. Milwaukee, Wis.

Play a SAX! Have Fun

Nothing will bring you so many friends or make you so popular as being able to play a saxophone. The new York Saxophone is easier to finger, easier to blow.

**6 DAYS
FREE
TRIAL**

With our free lessons you can be playing popular tunes in a short time. You can get this wonderful instrument, with its superb tone and perfect workmanship on six days' free trial in your own home.

Then if you decide to keep it you can take ten months to pay. Write at once for free saxophone booklet. Other York Band Instruments sent on the same easy terms. Free literature upon request.

J. W. YORK & SONS
Dept. 925-J, Grand Rapids, Mich.

YORK
Nothing to
Pay for but
Quality



**MANY EARN
\$75. to \$150. Weekly**

INSTANT WELD Welds Rubber Instantly. Better, quicker, and easier than vulcanizing. ONCE ON—ALWAYS ON. No Heat or Cement required. Repeat orders sure. Big profits. Appoint sub agents. Write today.

TOURISTS' PRIDE MFG. CO.
Desk No. 30-J Minneapolis, Minn.

**Write Today For Our
64 Page Catalog of
RADIO BARGAINS**
RANDOLPH RADIO CORP.
159 N. UNION AV. Dept. 3 CHICAGO, ILL.

The Shipshape Home

(Continued from page 128)

First the top pieces are mortised to receive the legs. Then the spreaders are nailed in place 4 in. back from each end. The legs next are nailed on; then the braces. Forty-four eightpenny common nails are used.—SAMUEL I. MYERS

How to Use Aluminum Paint

ALUMINUM paint has many uses in keeping a house shipshape because of its exceptional covering qualities and durability.

One should buy the aluminum bronze powder and varnish separately and mix them as needed. Any good spar varnish makes an acceptable vehicle.

To make aluminum paint, the powder should be added to the varnish in the proportion of 2 lbs. powder to 1 gal. of varnish. This proportion can be obtained by measuring out $\frac{1}{4}$ pt. powder (5/16 pt. to be exact) in a measuring-cup, pouring it into a container, then measuring 1 pt. of varnish in the same cup and pouring it over the powder. When the powder and varnish have been stirred thoroughly, the paint is ready to apply.

If the varnish is too thick, dilute it with from 10 to 20 per cent turpentine before measuring out and mixing with the powder. Only enough paint for one day's use should be mixed at a time, as the mixed paint will lose its brilliance and hiding power after standing for a few days.

This paint can be used on metal surfaces indoors or out. For outdoor service, however, two coats must be applied to give the necessary resistance to the weather. It will also serve well on wooden surfaces indoors. For outdoor use on wood, the varnish preferably should be diluted with about one-third its volume of boiled linseed oil so as to make a more elastic paint film.

According to experiments made by the Forest Products Laboratory, aluminum paint has a very high waterproofing efficiency. It therefore makes an excellent priming coat for wood. Its high impermeability to moisture keeps wood from cracking, checking, and swelling from absorption of moisture. It serves equally well as a finishing coat.

The more common uses of aluminum paint, such as for finishing radiators, water-pipes, steam-pipes, gas-heaters, furnace exteriors, and the like, are well known, but it is equally valuable on many other surfaces, indoors and out, where unusual protective and covering qualities are required.—JUNIUS D. EDWARDS.

Protecting Hardware

IN PAINTING woodwork or furniture it pays to remove the hardware if it can be done without much trouble. When this would require too much time, it is well to give the hardware a preliminary coat of vaseline. Any paint that gets on the metal, if allowed to dry thoroughly, can be wiped off bodily with the vaseline.

(Continued on page 130)

A SPECIAL OFFER

Made Only to the Friends of POPULAR SCIENCE MONTHLY

WOULD it not be grand to have some good friend tell you how you could easily make \$5.00—and by a little more work make many times \$5.00?

\$5 For You

For Giving a
little time to
POPULAR SCIENCE
MONTHLY

If you are one of the many readers of POPULAR SCIENCE MONTHLY who find this magazine interesting and useful, who feel that they could not do without it, then we know that you will be glad to tell a few friends that you like "Popular Science" and that you want them to read it too.

We have a plan we should like to tell you about, a plan by which we shall be glad to pay you Five Dollars, if you will undertake a few hours work for us.

And if you can devote more than a few hours to our plan, you can make many times the first five dollars.

Won't you write your address on the coupon below and send it to us today? We will explain the plan to you by return mail.

-----SIGN THIS COUPON TODAY-----

POPULAR SCIENCE MONTHLY,
250 Fourth Ave., New York, N. Y.

Gentlemen:

Please tell me about your plan by which I can earn \$5.00.

Name _____

Address _____

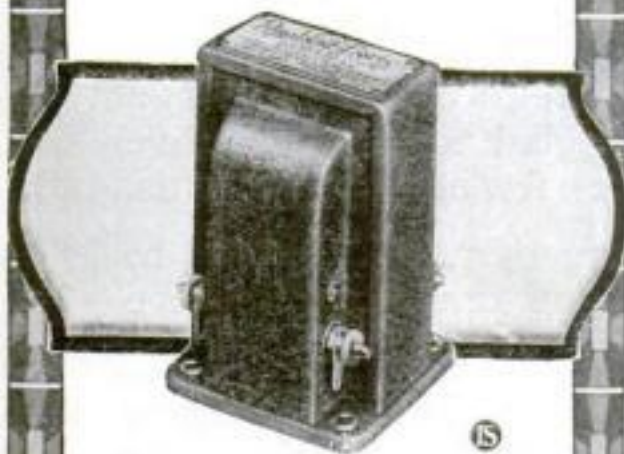
Occupation _____

10-25



Lullaby Radio-Crooned

Through the air of the evening, calm and sweet comes a cradle song from a distant city. Then, as never before, we feel the need of radio amplifiers which will bring out, strong and clear, just the pure beauty of music. For such moments is the joy of owning the one amplifying instrument selected by world-famed musical authorities for the purity of its tone: Rauland-Lyric.



Rauland-Lyric is a laboratory-grade audio transformer designed especially for music lovers. The price is nine dollars. Descriptive circular with amplification curve will be mailed on request. All-American Radio Corporation, 4201 Belmont Ave., Chicago.

Rauland-Lyric
AN
ALL-AMERICAN
TRADE MARK
TRANSFORMER
The Choice of Noted Music Critics

The Shipshape Home

(Continued from page 129)

Bracing Eave Troughs

IN MAKING fall repairs to the outside of your house, it is well to examine the eave troughs if they are of the suspended metal type, and make sure that they are rigid enough not to be pulled out of shape and otherwise damaged by ice and snow during the coming winter.

Damage of this kind, which is quite common, can be prevented in most cases by providing additional braces for the eave troughs. If they are of the common



NEW COPPER
WIRE BRACE

type hung with wire hangers, twist a length of copper wire in the outer eye of the hanger, draw it up to the roof and wrap it around a firmly driven nail; then return it and insert again through the eye. Fasten securely, drive the nail home, insert an eightpenny nail in the double wire and twist it until tight. Then remove the nail. Treat each hanger in this way.

If the trough is of a molded type, punch a small hole at the outer edge and proceed as with the half-round style.

If the hangers are of the malleable type and bolted on, a copper strap $\frac{1}{2}$ in. wide with a $\frac{1}{4}$ -in. hole $\frac{1}{2}$ in. from one end will serve the same purpose. Insert the hook of the malleable hanger in the $\frac{1}{4}$ -in. hole, draw the strap up tightly, and nail to the roof.—C. W. H.

Mice in Pianos

IN MY business as a piano dealer, I have removed hundreds of mice nests from pianos. The repair bills have ranged from \$5 to \$75. Indeed, it is astonishing the damage mice can do in a short time to a costly instrument.

For a long time I tried to find a way to make a piano mouseproof, but every

scheme involved too much work or too great expense. Finally it occurred to me to provide the mice with material for a nest so that they would not attack the piano felt.



This I did at first by placing in the lower right-hand corner of the piano a hatful of small rags, each about $\frac{1}{4}$ in. wide and 2 in. long.

That worked well, but later I found a simpler method. When I have the keys off at the time of tuning a piano, I place a folded newspaper under each register or compartment directly under the keys. I have never known a piano to be damaged by mice if either of these plans was adopted.—F. X. ALLEN.

FREE

140-page Book full of life-size ruled forms, each one completely filled in. The answer to problems of accounting and record keeping for any business or profession.

Send for this FREE Book today
John C. Moore Corporation
(Established 1839)
3025 Stone St., Rochester, N. Y.

MOORE'S LOOSE LEAF SYSTEMS

In Use In More Than 300,000 Offices

HEAT Without Coal

Amazing invention does away with coal or wood. The Instant-Gas Oil Burner sets in firebox of any stove or furnace; burns 96% air and 4% oil; Gives three times the heat of coal; and cheaper. Better cooking and baking. Installed without damage to stove in five minutes—to furnace in an hour. Over 60,000 in use; Sold on money-back guarantee; 30 DAY FREE TRIAL, and low introductory price to first users in locality. Write today for Free Book, "Scientific Oil Burning." Mention whether for stove or furnace. Underwriters Laboratories Inc., International Heating Co., Dept. 125-K, 1175 14th St., St. Louis, Mo.

Agents: We pay \$60 a week. Write for Free Sample Offer

Clear-Tone

TRADE MARK REG.

The Wonder-Working Lotion

Use like toilet water. Is positively recommended for quickly and permanently removing

PIMPLES, BLACKHEADS, ACNE

Eruptions on the face or body, Barbers Itch and Eczema, Enlarged pores, Oily or Shiny Skin. Endorsed by druggists, physicians, skin specialists, barbers, and over 100,000 men and women test cases, who succeeded with Clear-Tone after failing with everything else. Write today for my Free booklet, "A CLEAR-TONE SKIN," telling how I cured myself after being afflicted 15 years.

E. S. GIVENS, 153 Chemical Bldg., Kansas City, Mo.

You must see our new 64-page Catalog before you buy anything in Radio. It's FREE. WRITE TODAY!

RANDOLPH RADIO CORP.
159 N. UNION AV. Dept. 3 CHICAGO, ILL.

BECOME AN EXPERT ACCOUNTANT

Executive Accountants and C. P. A.'s. earn \$1,000 to \$10,000 a year. Thousands of firms need them. Only 5,000 Certified Public Accountants in the United States. We train you thoroughly at home in spare time for C. P. A. examinations or executive accounting positions. Previous experience unnecessary. Training under the personal supervision of William B. Castenholz, A. M., C. P. A., and a large staff of C. P. A.'s, including members of the American Institute of Accountants. Write for free book, "Accountancy, the Profession that Pays."

LaSalle Extension University, Dept. 1083-H Chicago
The World's Largest Business Training Institution

The Home Workshop



How to Construct

Couplers for a Model Railroad

By Edward E. de Lancey

MAKING model automatic couplers of the old fashioned "Miller" type may impress the average model-maker as an unpromising job, especially as these couplers now are obsolete. The writer, however, has made scores of them and has seldom met with difficulties. They are not apt to become uncoupled on curves, but when they do, the "check chains" always prevent a separation of the train.

As far as "looks" go, they may offend the eye of one who is accustomed to couplers of the Janney type, but that is a trifle compared with the crude appearance of the too widely spaced cars commonly

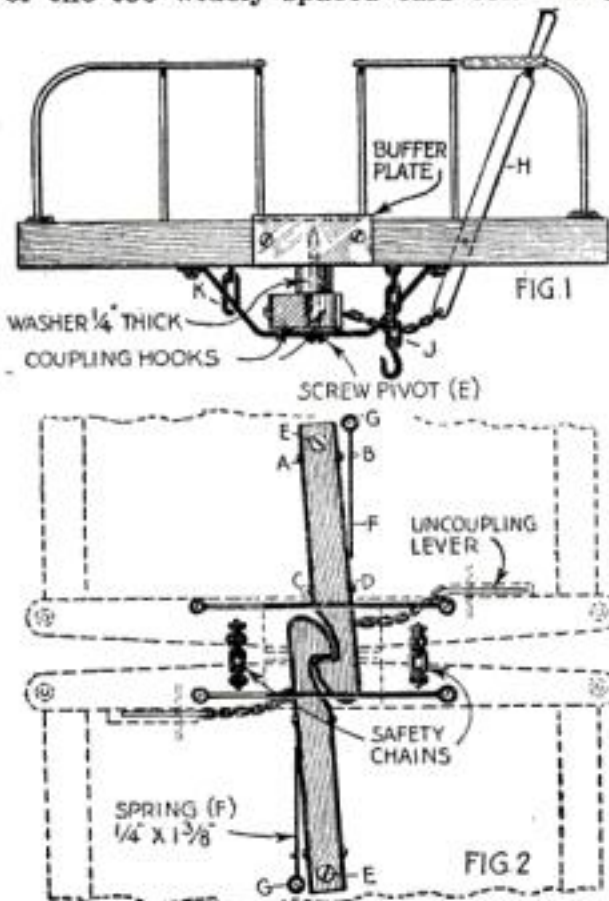


Fig. 1 is an end view of a coupler and Fig. 2, a plan view, looking down

met with. Furthermore, there is a gratifying "click" in the way in which a train comes together and couples in one's yards and stations.

The couplings may be made of $\frac{3}{8}$ by $\frac{3}{8}$ by $2\frac{1}{2}$ in. wooden strips, cut out with a scroll-saw to the shape shown in Fig. 2. These may be of any straight-grained hard wood, but soft pine can be used, provided a $\frac{3}{8}$ -in. strip of zinc is bound around the sides of the hook and bent so as to conform closely to its contour and fastened by the small brass screws A, B, C, and D.

The hooks must be secured at least $\frac{1}{4}$ in. below the bottom of the car with No. 5 brass screws (E), 1 in. long.

For locking, a piece of spring brass,

(Continued on page 132)

Ingersoll

YANKEE



\$1.75

The Most Popular Watch in the World

WHAT a tribute to an article to say that over a period of thirty years time more people have chosen it than any other!

Ingersoll Yankees have been chosen by 60 million people—in all parts of the world, in all walks of life.

Is there any better demonstration of the quality? Of dependability? Of value? Of genuine service?

The Yankee now on sale is a new model with many new features of grace and beauty—clean-cut, handsome and "easy-to-look-at."

"I Made \$7000 in One Year"

Sworn Statement by Frank DePries

He further states that he has made \$900 in one month's time, \$500 in a single day, individual sales of 180, 114 and 105 machines at various times. Mr. DePries has been with our company 8 years. Smith of Minn. reports for one week—43 hours, 44 calls, 28 sales, and \$166.20 profit. Robey, W. Va., quit a job at \$175 a month and now makes \$500 a month with us.



DePRIES

Approved by Underwriters

Any MAN can sell them--

Used by the U. S. Gov't., General Motors, Standard Oil, Ford Motor Co., and other big buyers.

AGENTS WANTED

We need more men like these, because the demand for our Super Fyr-Fyter is growing by leaps and bounds. Sells to garages, stores, factories, schools, homes, hotels, auto owners. Approved by the Underwriters. If you are willing to work and ambitious to make some real money, get our plan. You need no experience, as we train you without cost for the work. No great capital required. Good territory going fast. Better write us at once.

THE FYR-FYTER COMPANY

985 Fyr-Fyter Bldg.,

Dayton, Ohio



The up-to-date trains for up-to-date boys

IVES Trains have all the 1925 improvements. They are the *only* trains with electric locomotives (Series R) that you can stop and reverse by a touch of your finger on the control switch, located away from the track.

You boys will get a wonderful "kick" out of this reversing device—making the locomotive stop and back just like a real engineer. A mere touch of the finger does it! This year you can have an Ives Electric Reversing Locomotive on either O-gauge or 2¼-gauge track.

Both in action and appearance Ives Trains are exactly like the modern equipment of famous railroads. There is an almost endless variety of passenger and freight cars, electric target signals and semaphore signals with electrically-operated arms, bridges, tunnels, stations, and the efficient Ives Transformer. Prices range from the \$1.50 mechanical train to the big complete \$50 electric outfit. Sold by toy, department, electrical, hardware and sporting goods stores.

Send for the Ives Railroad Book

THE 32-page book of Ives Trains and Accessories contains illustrations in colors of the full line and tells all about the new 1925 features exclusive with Ives. Mail the coupon today with 10 cents. THE IVES MANUFACTURING CORPORATION, Dept. E1, 198 Holland Ave., Bridgeport, Conn.

IVES ELECTRIC AND MECHANICAL TRAINS

The Ives Manufacturing Corporation,
Dept. E1, 198 Holland Ave.,
Bridgeport, Conn.

Please mail me your 32-page railroad book.
I enclose 10 cents (stamps or coin).

Name.....

Address.....

City.....State.....

The Home Workshop

Couplers for Model Railroad

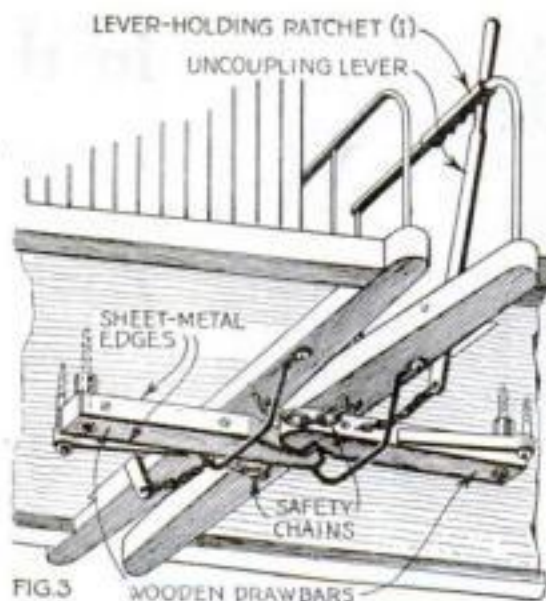
(Continued from page 131)

marked *F*, is placed behind each hook. It must be curled at one end for the attaching screw, *G*, and curved a trifle behind the open portion of the hook.

An uncoupling lever (*H*, Fig. 1) must now be made and pivoted on the left-hand side of the platform, through the slots already provided. A ratchet rack (*I*, Fig. 3) for holding this lever in any given position, may be made from a scrap of ¼ by 1 in. tin or zinc. One edge should have four or five sloping teeth filed on it. The other side is bent over about ⅛ in. and pinched or soldered on the hand rail just above the lever slot.

The buffer plates are sections of ½ by ½ in. angle brass, 1 in. long, attached over the center of the bumper beam by means of small countersunk screws.

The chains are of two sizes; the first, of small links, not over ⅛ in. long, for the uncoupling lever; the second, for the safety chains, with links almost ⅜ in. long. Sufficient chain of both kinds can



A pair of zinc-bound wooden couplers as installed under model railway cars

be had from the dealers in model-makers' supplies for a few cents.

The safety chain at the left of each car (*J*, Fig. 1) consists of a staple, four links, and an open hook. The one on the right (*K*) consists only of a staple and a link that is somewhat elongated in shape.

Now, with the hook level, ascertain the vertical distance between the top of the rails and the bottom of the hooks. Maintain this distance as a constant in all future cars and locomotives. It will be convenient to make a wooden templet for testing this height.

Attach the short piece of chain to the uncoupling lever, as in Fig. 1, making sure that the safety chain dangles *outside* the chain of the uncoupling lever. It will be convenient to provide a little hook, made of fine stiff wire, for hooking up the safety chains when the cars are coupled. A very fine buttonhook serves very well. Provide a place on the locomotive for stowing this tool.

In setting the main Miller hooks, leave a good 1/16 in. between the plane of the buffer plate and the plane of the back of the hook. This will allow ⅛ in. slack, which will be enough for all ordinary

(Continued on page 133)



"It's a Hohner!"

For nearly seventy years Hohner Harmonicas have earned and deserved the reputation of being "The World's Best." They are true in tone, accurate in pitch, faultless in construction and reasonable in price.

The Hohner Harmonica is a real musical instrument, endorsed and recommended by leading authorities as a "stepping-stone to serious musicianship."

Hohner Harmonicas are the individual choice of amateur and professional players everywhere. When you buy a harmonica insist on a Hohner; and ask for the Free Instruction Book. If your dealer is out of copies write M. Hohner, Inc., Dept. 182, New York City.

"That Musical Pal of Mine"



Tests Show Ford Can Run 41.4 Miles On Gallon of Gas

The amazing fact that a Ford can run 41.4 miles on a gallon of gasoline was recently brought to light through tests conducted by America's foremost engineers. Great strides have already been made in this direction by the recent invention of a simple attachment which can be installed in a few minutes without any alterations to motor. A. C. Winterburn made 41.4 miles on 1 gallon of gasoline after this device was attached. B. O. Weeks, famous aviator and inventor, wants agents and will send sample for trial. Write him today at 426-1452 Eleventh street, Milwaukee, Wisconsin.



ZIP-ZIP LET'S GO BOYS

No matter where you go, camping, hunting, fishing, boating, to the country, the seashore or the mountains, you will need a Zip-Zip shooter. Thousands of boys are made happy with this wonderful Zip-Zip shooter. If your dealer happens not to have them order them from us. ZIP-ZIP shooter complete only 35c or three for \$1.00 prepaid. Send stamps, coin or money order.



AUTOMATIC RUBBER CO.,

Dept. 22,

Columbia, S. C.

The Home Workshop

Couplers for Model Railroad

(Continued from page 132)

curves. In laying your track, try not to make any curves of shorter radius than 6 feet.

The first coat of paint should be merely a priming of white lead with plenty of oil in it. Allow this to become "bone dry" and very hard before applying the color coat. For the color you must choose your own, in accordance with the prototype you have selected. The writer found "Pullman green" satisfactory.

For the striping and lettering it is best to enlist the services of an expert. Nothing can more completely ruin an otherwise satisfactory model than a sloppy, amateurish job of lettering.

THROUGHOUT this series of articles, much super-detail has been avoided. If you have been painstaking, you will now find yourself the owner and motor-man of a fast electric locomotive, one which should be capable of hauling from three to five cars at fair speed.

Because of the somewhat complicated motions of each car while entering or leaving curves, it might be a wise precaution to substitute plain flat brass for the angle brass that we have recommended for the buffer plates. If this substitution is made, it will give you an opportunity of bending the buffer plate to match the general curvature of the platform ends, as a whole. This suggestion is made now because for simplicity's sake we have said nothing about placing equalizing springs behind the plates.

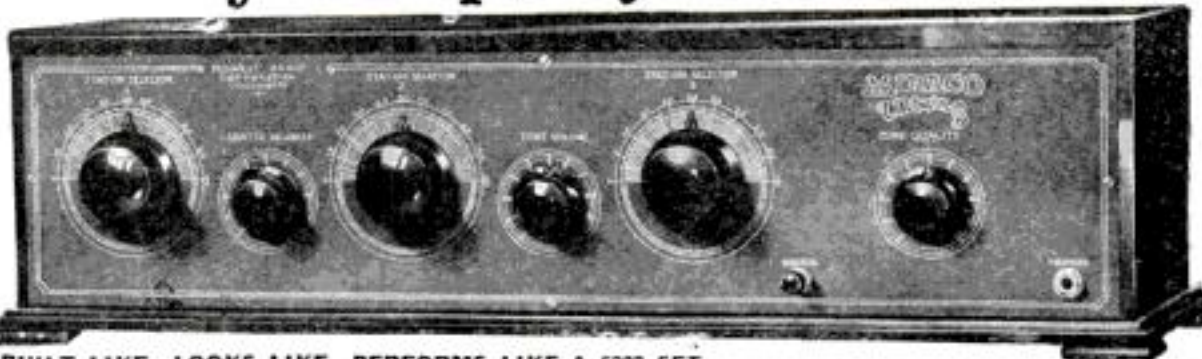
The writer has found that 3/16-in. square steel rod makes a satisfactory and cheap track, but it must be drilled and countersunk for 3/4-in. brads at about 1-ft. intervals. At all points where the third rail crosses the running rails there must be a few inches of "dead" track. This is necessary to prevent a short circuit at the instant the pick-up shoe passes over the running rails. Such a dead track can be provided by inserting running rails of wood, of the same cross section as the steel rails, at the crossing point. About 3 in. will be long enough, but they must be located directly opposite the crossing point.

The copper wire that runs along the top of the third rail need not in this case be interfered with. There will be no hesitation or irregularity in the motion of the locomotive at these dead points, because the locomotive has a pick-up shoe on each truck.

Because of serious ill health, the writer is compelled to postpone for the time being all discussion of passenger car and Pullman model construction. This is, therefore, the last article of the present series, which began in the March issue.

In all model work you will find that experience breeds skill. The farther you go, the greater your resourcefulness will become. Cultivate a placid frame of mind and you will find there is practically no limit to the things you can carry through to successful accomplishment. This, in addition to your own gratification, is the great reward of a model engineer.

Greater selectivity, range, power, beauty and simplicity—at lower cost!



BUILT LIKE—LOOKS LIKE—PERFORMS LIKE A \$200 SET
NOTICE! Enormous demand for the celebrated Miraco Ultra-5 (resulting from its many enthusiastic users so highly recommending it to their friends) has enabled us to add hosts of costly new features, refinements and improvements such as you might expect to find only on the newest sets selling at higher prices.

**MIRACO
RADIO
GETS 'EM
COAST TO
COAST**

Reports from
Ultra-5 users
everywhere
leave little for
us to add.
These letters
are typical of
the many in
our files and which we receive
daily.

Hears California to Europe
Enclosed is a partial list of the stations I received with the Miraco Ultra-5: KSD, WEBB, WBAV, WFAF, WLW, WCB, WHB, WOR, WJAZ, WOC, WHAS, WWJ, CKAC, KPIX, WCK, WHAZ, KFAB, WHAA, WASI, WCAP, WTAS, WOJ, KFKX, WAAR, WTAM, WOAI, WSOE, WCCO, KDKA, WBAF, WMC, CNRO, WIS, KHJ, WBZ, WMH, KFN, KFI, WEEL, WWI, WFAA, WAF, WGY, CKY, WRR, WCAE, WEAQ, WRC, FFD, WJJD, WGR, WABN, WCAL, WEB, WHN, WMAQ, WJZ, WLS, WOAW, WOO, WOS, CFAC, Sheffield, (Eng.): Paris (France). Carl H. Waukesha, Wisc.

Montana Hears California to Ireland

I am more than pleased with the Ultra-5 Receiver. I have 90 stations on my record in 20 days time including: KDKA, WCAL, KFLE, WFC, WCC, WIAM, WFAF, WEM, WGM, WCAL, WLW, CAM, CFCF, WJL, WAE, KAKE, KOOW, WCCO, WOC, WCAZ, WHO, WCCA, WOAW, CFAC, WOAI, WOS, KCHF, KFP, KBB, KPO, KFAA, WMC, CKY, WCCF, WMAQ, WBAF, WGN, KJR, WHJ, WOS, WMC, WJL, WGAN, KKO, WGW, WLW, WOO, WHB, WFAI, WJAZ, KGO, WCAF, KSAC, WTAP, KSKI, KFKA. On February 16th at 12:15 o'clock I received Ireland—the distance between seven thousand miles. Richard Comertown, Montana.

West Virginia Hears Australia
Got 2-XB Wellington, Australia, plain last night at 12:45 A.M., over the Ultra-5 Miraco you sold me. I am delighted and would not trade for any instrument in town. Geo. B. Glen Ferris, West Va.

Gets Coast to Coast and Canada
I received my Ultra-5 radio from you and I can say it is a wonder. We have received stations from coast to coast and also Canada. Orie E. Lacona, Iowa.

now only \$59.50 retail

SEND FOR SPECIAL OFFER!

The Powerful New
**MIRACO
Ultra-5**

(FIVE TUBE OUTFIT IN BEAUTIFUL MAHOGANY CASE)

The amazing coast to coast reception (on the loud speaker) and international receiving range of the famous Miraco Ultra-5 in the hands of its multitudes of pleased users—as voluntarily reported by them to us in writing—offers proof of performance which makes claims by us superfluous. Send for plenty of this proof—and our remarkable Special Offer—at once! Remember that one of America's oldest and most reliable manufacturers of quality sets completely builds, thoroughly tests and factory guarantees each Miraco. That longer experience and immense production make possible such money-saving prices. Bear in mind that this big, beautiful, powerful and clear-toned Miraco Ultra-5 is the latest, improved model. That it has a beautifully gold-etched genuine Formica panel with large Bakelite knobs equip-

ped with gold filled indicators for very fine tuning. That it is even more selective, more powerful and is capable of getting greater distances due to exclusive use of "Duoformers" (ultra low-loss inductance coils—the newest achievement in radio engineering.) "B" battery consumption is minimized and oscillations are controlled on all wave-lengths by a new patented feature, the "Counter-Balancer." Flexibly wired (to prevent broken connections.) Has an adjustment for different length aerials, only two rheostats, a cut-out switch, concealed wiring and other features of costliest sets. Comes in a handsome hand-rubbed mahogany cabinet. An instrument thoroughly tested and approved by radio's highest authorities and one which anyone can easily connect, operate and "log." Works on storage or dry batteries. Literature describes other latest improvements—use coupon.

Other Miraco Long Distance Sets \$13.95 retail

Wonderfully improved new models in one-tube and three-tube Miraco Long Distance Sets also ready at lower prices! Powerful new Miraco R-8 at only \$21.50 (retail) operates loud speaker on distant

stations. All Miraco sets work on storage or dry batteries. Approved by Radio's highest authorities. Unmatched value! Let testimony of users convince you. Write for literature and Special Offer.

All the Proof you want is waiting for You!

Reports from their hosts of users in every state prove Miraco sets—at rock-bottom factory prices—outperform sets costing much more money. Send for latest literature, SPECIAL OFFER and plenty of additional testimony from users leaving no doubt that "Miraco Radio Gets 'em Coast to Coast."

AGENTS, DEALERS
Write for the new
Miraco proposition!

SEND COUPON FOR SPECIAL OFFER.

MIDWEST RADIO CORPORATION
Pioneer Builders of Sets, 408-E, E. Eighth St., Cincinnati, O.
Send free literature, SPECIAL OFFER and all particulars regarding Miraco Sets. () Jobber () Dealer () Agent () User
NAME.....
ADDRESS.....



YOU CAN BUILD THIS IDEAL WORK-BENCH—YOURSELF

THE pleasure of working with tools at home is greatly increased if you have a strong substantial bench with a good vise. One that also has drawers and tool cabinets is a constant incentive to keep tools in order and give them the care and attention they deserve.

A blueprint of the Home Workbench illustrated, with full size details and bill of materials may be obtained by sending 25 cents to —

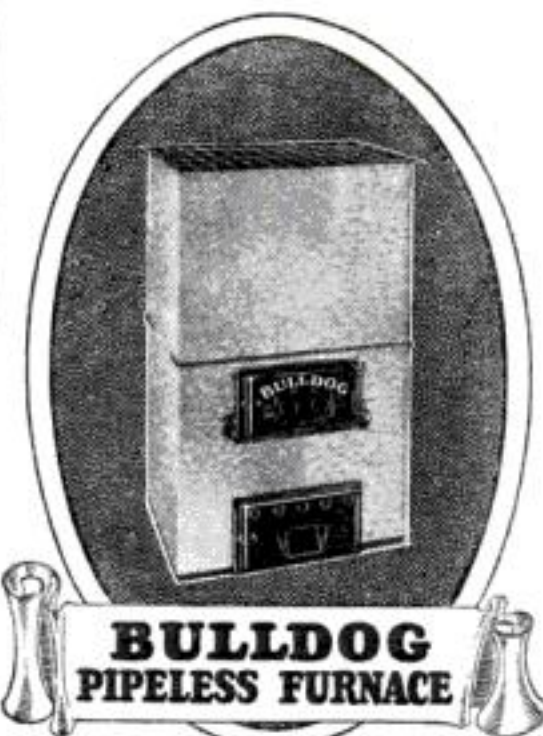
POPULAR SCIENCE MONTHLY
250 FOURTH AVENUE NEW YORK

2½ Tons Heats 5 Rooms!

"There is no heater to compare with the Bulldog. I burned 2½ tons of coal last winter and heated five rooms and bath."
—Walter Geary, Gloucester, Mass.

That's what the Bulldog does with coal! Here's what it does with about the lowest grade fuel you can think of!

"I can run my Bulldog furnace steady for fourteen days in normal weather conditions on the actual cost of fifty cents." So writes F. R. Redetzke, of Cleveland, North Dakota, and he adds: "Hard to believe, is it? That's what some of my neighbors thought until I showed them! We have an unlimited amount of grain screenings in this country. That's the fuel I am using."



Comes Completely Erected!
Fits Any Height of Basement
Goes Through Any Door
You Install It Yourself!

If you are even thinking of a pipeless furnace, or any furnace, write for our free catalog. The Bulldog is one furnace you MUST investigate. Comes completely erected, fits any height of basement, goes through any door, and you install it yourself! A really extraordinary development in heating.

No Money Down!

The Bulldog is sent you for free inspection. Then, if satisfied, you make only small monthly payments, at our amazingly low price! Factory connections in both East and West. We ship from nearest point. Don't consider buying any furnace until you find out about the Bulldog. Write at once for our special offer and our free catalog, together with the wonderful record of Bulldog success. Get ready for winter NOW! Mail this coupon TODAY!

Babson Bros.

19th & California Ave., Dept 13-57 Chicago
Without obligating me in any way please send me your free catalog and special offer on the Bulldog Pipeless Furnace.
Print name and address plainly.

Name

Address

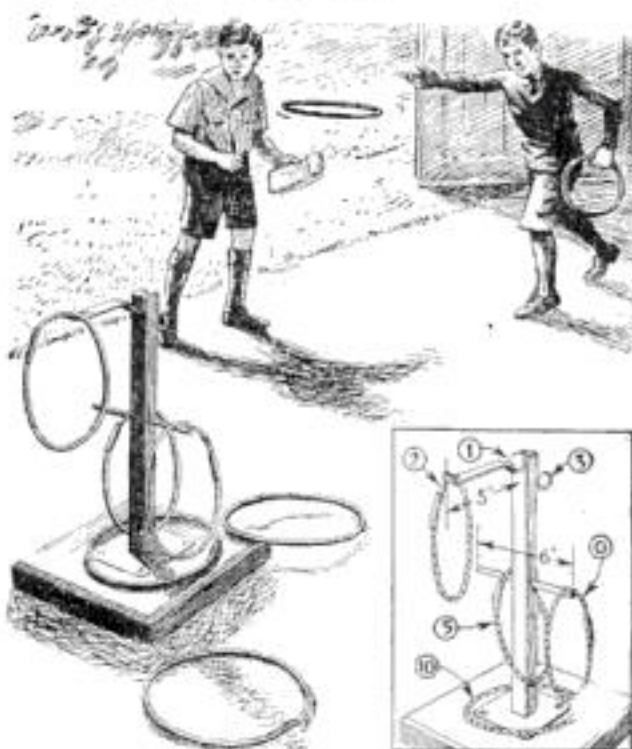
The Home Workshop

"Luck-o'-Ring" Is Novel Variation of a Familiar Children's Game

BOTH luck and skill are required in the fascinating and novel game illustrated. A stick $\frac{3}{4}$ by $\frac{3}{4}$ by 14 in. is screwed to a piece of sheet metal, which is fastened in turn to the wooden base, $\frac{3}{4}$ by 10 by 10 in.

A piece of spring brass $\frac{3}{4}$ in. wide is bent and fastened to the top of the standard, as shown, to provide three places upon which a ring can catch. A $\frac{1}{4}$ -in. dowel 6 in. long is passed through the standard at right angles to the brass piece and about halfway between the top and bottom. The rings are made from 24-in. lengths of $\frac{1}{4}$ -in. stiff rope, the ends being clamped with thin metal pieces 1 by 2½ in.

It will be noted that the number of points won by a successful pitch is determined by the position in which the ring lands. If it merely hooks on the dowel, no score is made, but the player receives an extra try. At the end of nine innings, the player having the larger score is the winner.—D. W. C.

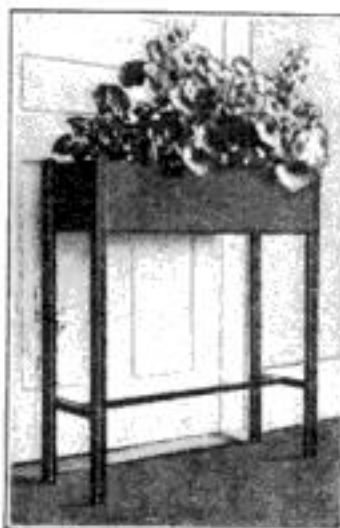


The players stand about 10 feet from the post and take turns pitching their rings. Three rings are colored red and three green.

Neat Fernery Built on Simple Lines

TO BUILD the simple yet attractive fernery illustrated, obtain four pieces of hard wood 1 by 1 by 31 in. for the legs, one piece 1 by 1 by 40 in. for the long and short lower cross bars, and one piece $\frac{3}{8}$ by 6 in. by 6 ft. for the sides and ends. This material must be free from knots and thoroughly seasoned.

The metal parts are five pieces of $\frac{1}{4}$ -in.-round iron rod 8 in. long, to support the earth box, and a sheet of



galvanized iron approximately 17½ by 34½ in.

In cutting the wood to the correct length, use a miter box as far as possible to insure square joints. Select the pieces with the prettiest grain for the sides and ends that are to be exposed, and sandpaper thoroughly all the surfaces that will be seen.

With a $\frac{1}{4}$ -in. bit, bore five holes $\frac{1}{2}$ in. deep on the inside of the side pieces to form sockets for the iron rods. The center of these holes

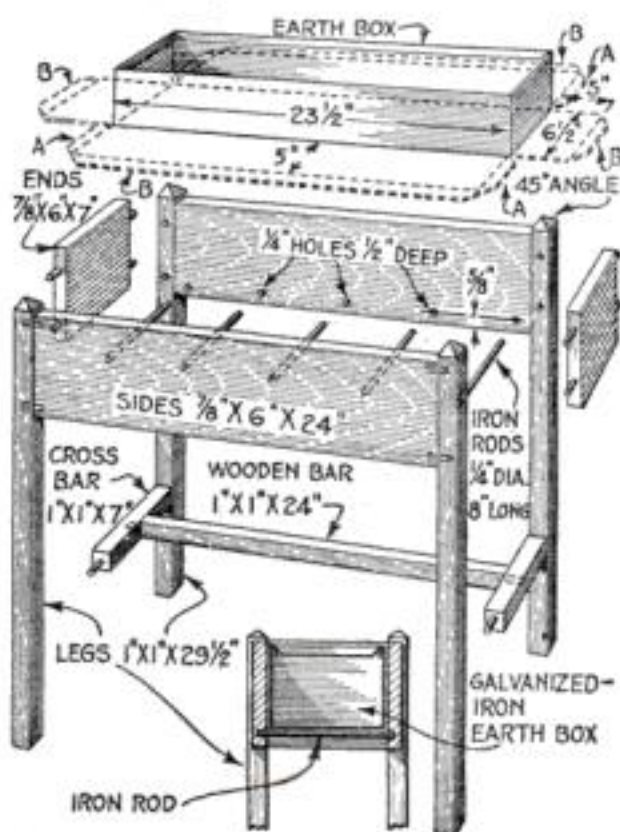
should be $\frac{5}{8}$ in. from the lower edges.

The assembly requires 22 dowels $\frac{3}{8}$ by 1½ in. Bore all the dowel holes, taking care not to center the holes in the legs so that one dowel will strike another.

Put the parts together with hot glue by assembling first the long and short cross bars and then the two sides with the legs. On one of the assembled sides fasten the two ends; then add the assembled cross bar. Place the iron rods in their holes and add the remaining side.

In making the earth box, scribe lines on the galvanized iron, as shown, cut out the piece and bend the four tabs marked A at right angles over a straight-edge. The four tabs marked B should be rolled right over and drawn down tight against the side so as to make a neat rolled edge for the top of the lining. The sides and ends then are bent up with the tabs A inside, and the joints are soldered.

The finishing may be done in any preferred way. A coat of stain, fixed with a thin coat of shellac, and two coats of spar varnish is a desirable finish.—FRED E. FOX.



How the fernery is put together and method of making the galvanized-iron lining

Better Shop Methods

Old Bill Says—

KEEP your tools well shaped and sharp. When a tool gets dull, stop and grind it.

Some men waste a lot of time talking about the imperfections of their tools and machines; they will get ahead faster if they put more thought and energy into the actual doing of the task in hand.



Old Bill, machine-shop foreman

Mill files often will work smoother when rubbed with chalk on both sides after cleaning.

An exceptionally good workman always seems to have an exceptionally good job.

A leather belt always should be run with the hair or grain side toward the pulley; the belt is less apt to crack, will last longer, and will transmit more power.

A medium soft wheel is best for sharpening a milling cutter.

Never bite off too much at one time—go slowly but surely.

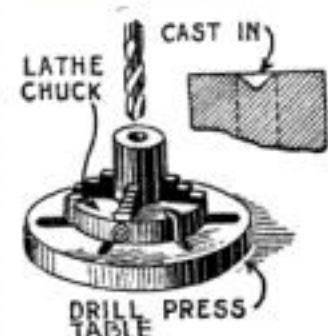
Being slow and sure is different from just being slow.

No horseplay in the shop! Too many men have been made cripples by playing around the machines.

It sounds better to hear a man say "I did" than "I'm going to."

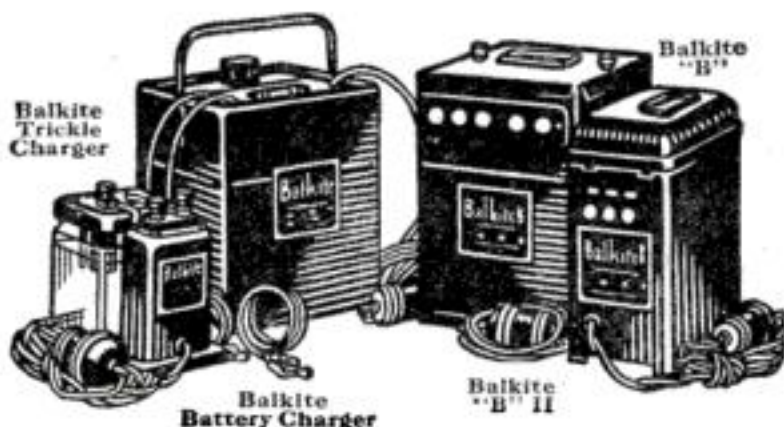
How to Drill Small Bushings, Pulleys, and Gear Blanks

IN MAKING bushings, pulleys, and gear blanks from iron, brass, or bronze castings, nothing is to be gained by having the hole cored if its diameter is 1 in. or less. The more satisfactory way is to have the castings made solid. A drill will cut cleanly through the solid metal without as frequent regrinding as if it were biting into a rough, cored opening.



Short bushings with small holes can be held in a lathe chuck bolted to the table of a drill press and drilled and reamed more rapidly than in a lathe.

(Continued on page 136)



Balkite Radio Power Units

the ideal radio power supply

The Balkite Battery Charger and Balkite Trickle Charger for charging "A" batteries—entirely noiseless. Balkite "B" replaces "B" batteries—for sets of 5 tubes or less. Balkite "B" II—for sets of 6 tubes or more.

FANSTEEL PRODUCTS CO., Inc., North Chicago, Ill.

FANSTEEL [®] Balkite [®] Radio Power Units

BALKITE BATTERY CHARGER · BALKITE TRICKLE CHARGER · BALKITE "B" · BALKITE "B" II



MAGNATRONS have achieved leadership in the vacuum tube field, but the constant vigilance which has brought these tubes to the fore has not for one moment been lessened. Every part, from contacts to filament, is tested, constantly tested.

The Magnatron DC-201A, DC-199, and DC-199 (large base) now list for only \$2.50 each.

Connewey Electric Laboratories
Magnatron Bldg. Hoboken, N. J.



MAGNATRONS



"The Best Aerial is a Beldenamel Aerial"

LEADING radio engineers agree that an enameled aerial is superior to a bare copper aerial, because the rapid corrosion of the bare copper wire, exposed to atmospheric fumes and smoke, quickly reduces the aerial efficiency.

Use a Beldenamel Aerial, because every strand is coated with baked Beldenamel to keep the wire bright and shiny. You do not have to clean a Beldenamel Aerial. The Beldenamel coating is not affected by moisture or atmospheric fumes. It lasts indefinitely. Try a Beldenamel Aerial, and hear the difference.



Belden

Send for Free Illustrated Booklet

Belden Manufacturing Company,
2304-E So. Western Ave., Chicago.

Please send me your latest illustrated booklet, free, describing Belden Radio Products and their use in radio work.

Name.....

Address.....

Send for Latest RADIO CATALOG and GUIDE



SETS, PARTS, KITS BIG SAVINGS

You need this big FREE book. A practical guide to successful set building. Gives advanced book-ups. Shows all newest parts and kits at prices far below others. Send today. Build the newest sets. Make more money.

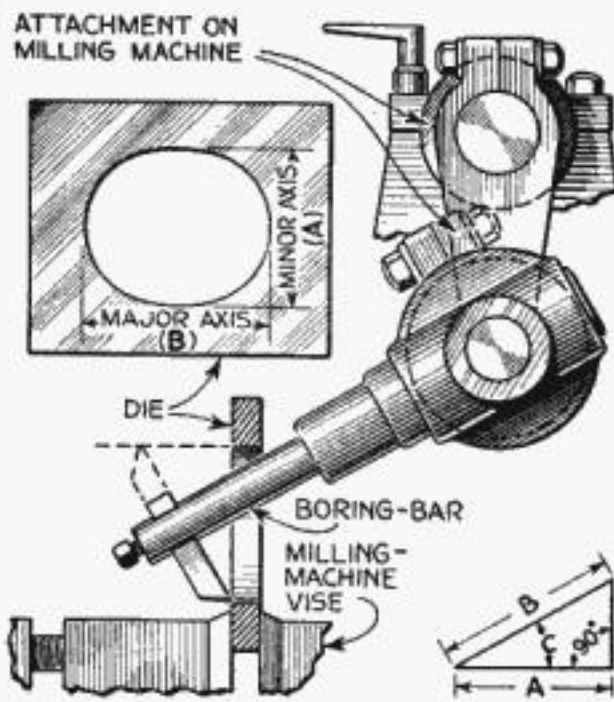
BARAWIK CO.
102-122 S. Canal St., Chicago

Better Shop Methods

Milling Machine Used for Cutting an Ellipse

DIE-MAKERS having to machine elliptical holes may avoid the tedious and difficult task of filing to a line after drilling out the core if they have access to a vertical milling-machine attachment. By using the method illustrated a perfect ellipse may be generated. The die blank is held in a vise or on an angle plate, as convenient. A boring-tool is held in the attachment in the usual way.

For ordinary work the angular setting of the attachment may be found by laying out the work on paper and measuring the angle with a draftsman's protractor. If A is the minor axis of the ellipse and B the major axis, lay off a right triangle with A as the base and B the hypotenuse.



Milling machine set to cut an ellipse, and how to find the correct angle by means of a diagram

The angle C between these sides is the angle to which to set the attachment.

The angle may be computed for more accurate work. The cosine of an angle is equal to the side adjacent to the angle divided by the hypotenuse. In the illustration, A is the side adjacent, and B the hypotenuse. Assuming that these are 4 and 6 in. respectively, then the cosine of the angle C is four divided by six, or .666. Referring to a table of natural sines and cosines to be found in any machinist's handbook, the cosine .666 is found to belong to the angle 48 deg. 46 min. This represents very accurately what the angular setting of the attachment must be.

How to Drill Small Bushings

(Continued from page 135)

Then they are finish-turned on an arbor between centers in the usual way.

When it is desired to machine bushings in this way, a center can be cast in one end for starting the drill, as illustrated. This saves laying out the center. All that is necessary is to chuck the work as previously suggested and bring the drill to bear in the center of the casting.

A COMPOUND of ten parts tallow to one part mercury is a dependable help in keeping tools from rusting.

**I Made \$21.00
In Five Hours**

—Writes Peter Werner, III.
Sell Madison "Better-Made" Shirts for Large Manufacturer Direct to wearer. No capital or experience needed. Many earn \$100.00 weekly and bonus.

Write for Free Samples

MADISON SHIRT M'FRS, 535 Broadway, New York

Tire Agents Wanted

Use and Introduce MELLINGER CORD TIRES
15,000 M.I.L.E.S. GUARANTEED

Lowest Wholesale Prices in America. Shipped prepaid on approval. Make big money all or part time. No capital or experience. Sample sections furnished.

YOUR TIRES GIVEN

Simply send name today for FREE BOOK, telling how thousands do big business. Special Agents' Offer. Wholesale Prices and FREE Sample Kit. MELLINGER TIRE & RUBBER CO., Dept. 310, Philadelphia, Pa., or Kansas City, Mo.



MOTORCYCLES

LESS THAN HALF COST

Ace, Indian, Cleveland, Harley-Davidson, Henderson Motorcycles and Sidecars, new, used and rebuilt. **Wanted. Agents** Wanted. Write for FREE trial offer, agent's free outfit and big bargain booklet. New American Bicycles in different styles and colors. Write for illustrated catalog giving our money saving prices.

AMERICAN MOTOR CYCLE CO.
2047 W. Chicago Ave., Dept. 1034 Chicago

CLASS 25¢ PINS

BUY DIRECT FROM THE MAKER
CATALOG FREE

Either pin shown made with any 3 letters and 2 figures. 1 or 2 colors enamel. Silver plate 25¢ ea. \$2.50 doz. Sterling silver. 40¢ ea. \$4.00 doz.

BASTIAN BROS. CO.

631 Bastian Bldg., Rochester, N. Y.

Mr. Brush Salesman

Unusual opportunity is offered for aggressive, ambitious, hustling men to represent an old established manufacturer of high grade, guaranteed, fastest selling line of Sanitary Twisted in Wire Brushes, sold direct to the Home. We have openings for experienced brush men as managers in all territories. We want live wire, energetic Getters. We pay larger commissions than any other Brush House in the Country. If you want to earn some real money, it will pay you to write us immediately for our proposition. **WIRE GRIP SANITARY BRUSH CORP., 15 Mercer Street, New York City.**

64 Illustrated Pages of Radio Bargains! Write for Catalog Today

RANDOLPH RADIO CORP.
159 N. UNION AV. Dept. 3 CHICAGO, ILL.

\$3 DOWN AFTER TEN DAYS TRIAL FOR THIS LONG WEARING TALL BEARING L.C. SMITH

NO RED TAPE—NO DELAY
Test this wonderful typewriter in your home or office 10 days. Send No Money. If you are not satisfied it is the best buy you ever made. Your express agent will refund your \$3 deposit.

LOWEST PRICES ever made on the world famous L. C. Smith—full size—all late style operating conveniences—absolutely highest quality rebuilt—5 Year Guarantee. Small Monthly Payments.

FREE: Course of Instruction, Tools, Waterproof Cover, all free to you now. Send today for New Special Offer and Booklet of valuable typewriter information.

Smith Typewriter Sales Corp.
321-360 E. Grand Av., Chicago

DEAFNESS IS MISERY GOOD HEARING A JOY

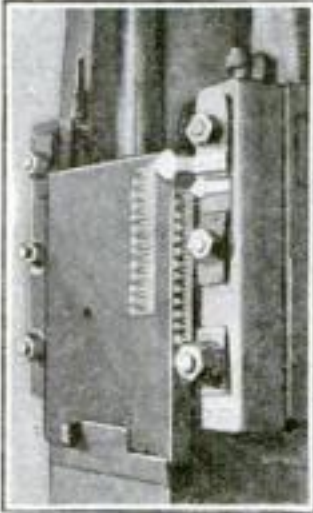
Millions of people know that, but Multitudes of persons with defective hearing and Head Noises are again enjoying conversation, go to Theatre and Church because they use Leonard Invisible Anti-septic Ear Drums, which are Tiny Megaphones fitting in the Ear entirely out of sight. No wires, no batteries, no head piece. They are Unseen Comforts and inexpensive. Write for booklet and sworn statement of the inventor who was himself deaf.

A. O. LEONARD, Inc., Suite 144, 70 5th Ave., New York

Better Shop Methods

Scales Fixed to Steam Hammer Save Blacksmiths' Time

B L A C K - S M I T H S who forge large work under the steam hammer will find that a scale attached to the hammer will save them much of the time they otherwise would spend in caliper-ing their work. The illustration shows two scales, one of which is visible from the front and the other from the side. When the dies are planed, the indicator point is reset.—ALEX. C. FABRIS.



Scales on hammer

Rubber Hose Used as Safety Holder for Chisel

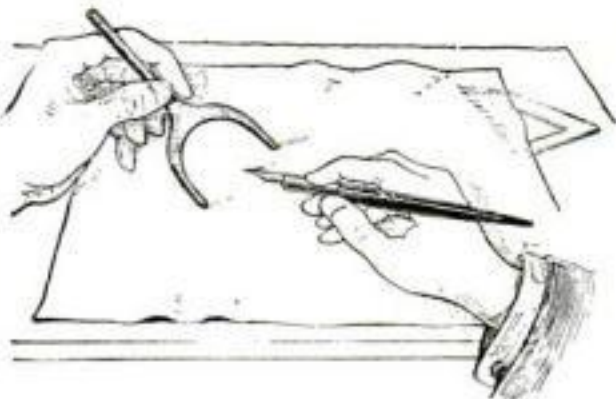
MANY a workman has suffered severe injuries to his hand when his hammer glanced from the head of a chisel or punch that he was holding. In order to eliminate this risk, the service supervisor in a large concern in the State of Washington made a safety holder from a piece



This safety chisel holder is made of a short length of hose and two pieces of wood

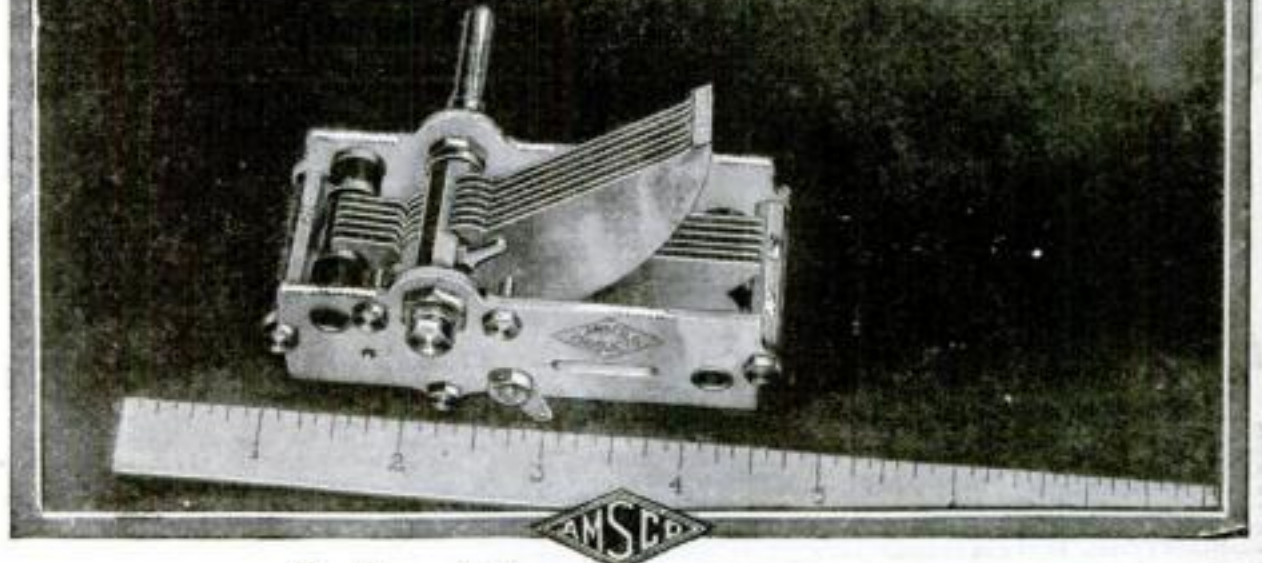
of discarded air hose. He cut a slot about 1½ in. from the end of the hose to take the chisel or punch and drove a piece of wood into each end to retain the tool firmly in position. With the aid of this holder it is an easy matter to direct the tool accurately.—GEORGE F. PAUL.

Tracing Paper and Cloth Held Flat with a Wooden Fork



LARGE sheets of tracing paper, cloth, or thin drawing paper, very often do not lie flat on the drafting table, particularly on and after damp days. Under these conditions the sheet can be held down as shown, by means of a fork-shaped piece of wood.—A. E. Z.

AMSCO ANNOUNCES A SPACE- SAVING S.L.F. CONDENSER



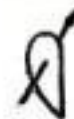
Solved! The space problem of the straight-line frequency condenser. The new AMSCO Allocating Condenser is ingeniously designed to save room in the cabinet, yet spreads the stations evenly around the dial, according to frequency. Greatly improves the selectivity of the set, and simplifies tuning. Three sizes, Single or Siamese.

Ask your dealer or write Dept. G

AMSCO PRODUCTS, INC.

Broome and Lafayette Streets, New York City
MAKERS: MELCO SUPREME RADIO RECEIVERS

Half a Heart is the secret. Half a Heart is the shape of the rotor plates.



Half a Heart is the new symbol for efficient S. L. F. variable condensers.

Make More Money

Read the Money Making Opportunities on pages 146 to 174 of this issue.

Buy Now Pay Later

Get Boice Prices Before You Buy!

As the world's largest builders of small bench machines, Boice offers greater values at lower prices with a positive money-back guarantee. Whatever you build, there's a Boice-Graze bench machine to do your work. Circular saws, Band saws, Lathes, Jointers and Drills. Write for literature, prices and the Boice K-Z Pay Plan before you buy.

8 Inch Bench Lathe

Turns wood and soft metal. Swings 8-in. maximum over bed. Capacity 19-in. between centers. Headstock integral with heavy cast-iron bed. 3-speed cone pulley for 1-in. flat belt for motor or counter-shaft drive. Replaceable bronze bearings. Headstock and tailstock have No. 1 Morse taper. 3-8-in. hole thru headstock spindle. Can be fitted with jig saw, circular saw and sand disc attachments. 3-in. scroll chuck, 1-2-in. Jacob's chuck and arbor for emery or buffing wheels.



Junior Saw

A speedy accurate machine of all-metal construction. Table 10-in. x 12-in. Saws 1 1/2-in. stock; dados 5-8-in. x 5-8-in., driven by any 1-4 to 1-2 H. P. motor. Portable. Attaches to light socket. Table elevates for grooving. Attachments for grooving, sanding, grinding and drilling. Sold with or without motor and base.



W. B. & J. E. BOICE
Dep't. P. S. 10-A Toledo, Ohio

A Handy Sewing and Work-Table Easily Made at Home



Every woman would like this table that combines the convenience of the ordinary sewing table with a large flat top for spreading out her work.

Any man who uses tools can easily build this simple combined sewing and work-table from blueprints, which we will supply for 25c. The blueprint includes a list of the material, size and quantity of each item required for the handy table.

POPULAR SCIENCE MONTHLY
250 Fourth Avenue New York



Easy to Draw Cartoons

When Shown in the RIGHT WAY

Some of the cleverest cartoonists and comic artists learned how to draw in their spare time by following Cartoonist Evans' Simple and Easy to Learn Method and are now MAKING GOOD MONEY. Send one of your drawings, and let Mr. Evans see if you have ability and receive the Portfolio of Cartoons and full details about the course. It is not expensive.

THE W. L. EVANS SCHOOL OF CARTOONING
825 Leader Building Cleveland, Ohio

"DON'T SHOUT"



less and harmless. Anyone can adjust it. Over one hundred thousand sold. Write for booklet and testimonials.

THE MORLEY CO., Dept. 797, 10 S. 18th Street, Philadelphia

Stop Using a Truss



Reduced
Fac-Simile
Gold Medal

STUART'S PLAPAO-PADS are different from the truss, being mechanico-chemical applicators made self-adhesive purposely to hold the distended muscles securely in place. No straps, buckles or spring attached—cannot slip, so cannot chafe or press against the public bone. Thousands have successfully treated themselves at home without hindrance from work—most obstinate cases conquered. Soft as velvet—easy to apply—inexpensive. Awarded Gold Medal and Grand Prix. Process of recovery is natural, so afterwards no further use for trusses. We prove it by sending Trial of Plapao absolutely **FREE**. Write name on Coupon and send TODAY.

Plapao Co., 790 Stuart Bldg., St. Louis, Mo.
Name.....
Address.....
Return mail will bring Free Trial Plapao

BLANK CARTRIDGE PISTOL

Protection against Burglars, Tramps, & Dogs



Well made and effective; modelled on latest type of Revolver; appearance alone is enough to scare a burglar. When loaded it may be as effective as a real revolver without danger to life. It takes standard .22 Cal. Blank Cartridges obtainable everywhere. Price 50c. Superior quality \$1.00 Postpaid. Blank Cartridges, by express, 50c per 100.

Johnson Smith & Co., Dept. 418 Racine, Wis.

NATIONAL SPORTSMAN

is a monthly magazine crammed full of hunting, fishing, camping and trapping stories and pictures, valuable information about guns, revolvers, fishing tackle, game law changes, best places to get fish and game, etc. Biggest value ever offered in a sporting magazine. And here's a knife that every man and boy should own. Has a sturdy master blade of good full size and extra gauge of a shape especially useful for hunters, trappers, campers, and fishermen and a punch blade which can be used for a multiplicity of purposes. This knife is 3 1/4 inches long, with 18 per cent nickel silver bolsters and shield, and is of solid construction throughout and has a good full handle to fit the grip of a large or even over-sized hand. The name "Remington" on the blade is your guarantee of quality.



Special Offer: We will send this knife and National Sportsman for 6 months on receipt of \$1 National Sportsman Magazine, 255 Newbury St., Boston, Mass.

NATIONAL SPORTSMAN



Both for
\$1

Better Shop Methods

Simple Ways to Gage Heat of Small Shop Furnaces

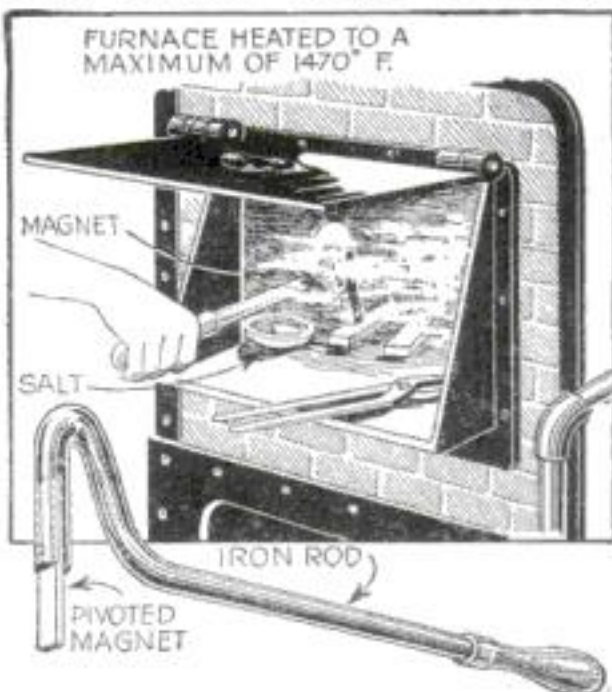
While letters from readers in remote parts of the world are received frequently by **POPULAR SCIENCE MONTHLY**, it is not often that a contribution is submitted by a foreigner in such clearly written English that it can be used practically without editing. This was true, however, in the case of an article written by L. Israilevich of Leningrad, Russia. It was accompanied by a letter in which he said:

A few days ago I happened to read a few issues of your magazine and I just took to it, if there is such an expression in English. I am a constant reader of various other popular magazines, but your magazine seems to strike a different note, which is somehow mighty pleasing to me.

Well, I am sending along a short article for the Workshop Department. The idea, though not exactly new, is carried out with such simple means that the method is quite suitable for small shops, garages, etc.

Mr. Israilevich's article is as follows:

TESTING the heat of tool carbon steel in a furnace is done in most small shops by the eye. This requires a lot of experience and, being founded on subjective perceptions only, leads often to costly mistakes through overheating.



Salt used to show overheating and a magnetic tester to indicate the correct quenching heat

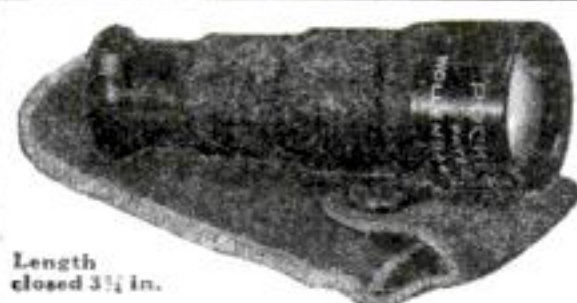
By the use of a few simple devices, it may be made possible, however, to determine easily and certainly the required degree of heating.

The method consists essentially of so heating the steel that its temperature never exceeds nor is lower than certain temperature limits.

To prevent overheating, the temperature within the furnace should not exceed 1470° F. This is accomplished easily by placing a porcelain dish with common salt into the furnace and adjusting the heat every time the salt begins to melt, which it does about this temperature.

For the lower limit we can make use of the property of steel to lose its magnetic qualities when heated to its proper quenching temperature. Carbon steels used for most machine-shop tools—screw taps, milling cutters, dies, etc.—have this property in full measure. This can be said generally of most kinds of carbon steel containing from .9 to 1.4 per cent of carbon. As to steel with .7 to .9 per cent

(Continued on page 139)



This clear, accurate, powerful 6 Power Pocket Telescope

(Genuine Wollensak)

\$2 Postpaid with
leather case

Made by one of the finest lens makers in the world. Guaranteed by both this company and the maker. No bigger'n a jack-knife, easily carried in vest pocket yet a powerful, precise monocular, that brings distant objects close, in full detail without the "vibration" present in higher power telescopes. Adjusts twice as quickly as binoculars. Nothing cheap in appearance or construction. Black baked-in enamel with non-slip grip. Soft leather case with glove snap included. \$2 prepaid. Money back if not thoroughly satisfied.

BOSTON SPORTING GOODS CO.
Dept. Q, 80 Boylston St., Boston, Mass.

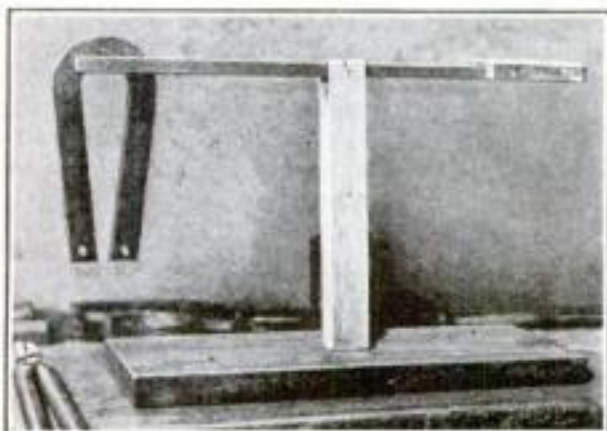
Better Shop Methods

Ways to Gage Furnace Heat

(Continued from page 138)

of carbon, certain restrictions should be applied, for below .9 per cent there is a temperature range when steel loses its magnetic properties before attaining the correct quenching heat. This restriction is practically of small importance, however, and can be corrected by heating for a little longer time.

To determine the moment steel loses its magnetic properties, a magnet in the form of a balance must be constructed. If pieces are brought to it during the heating process, the moment of cessation of its being set oscillating by this action will fix the proper quenching heat. It generally is better not to bring the piece to the balance, but to put it the other way



Another magnet balance for determining the correct temperature for hardening steel in the way described by Mr. Israilevich. This device was made by William J. Edmonds, Jr., of Whitehall, N. Y., for emergency use when a regular pyrometer was not available

around, because in the first case the piece has a chance to get considerably cooler before it is plunged into the quenching bath. Of course, this may be offset by heating the piece to a little higher temperature, which is quite safe.

The magnet may be made of an old file. Care must be taken to saw the ends off squarely and not in an arc, as in the latter case the lines of force disperse and the magnet becomes somewhat weaker. A convenient way of mounting it is shown in the accompanying drawing (on the preceding page). The attraction between the magnet and its iron mounting will cause it to retain the position shown.

Sometimes, when the magnet cannot be employed directly, as when a portion of the piece is heated, a trick may be resorted to. It consists of heating along with the main piece another smaller piece of steel of the same composition and determining by it the temperature of the main piece.

Remedying Loose Pipe Joints with Brass Wire Cloth

WHEN threads are cut in a lathe on pipes that are $2\frac{1}{2}$ in. or more in diameter, it sometimes happens that the correct diameter is not obtained and the fitting will screw on loosely, right up to the shoulder. The joint can be made tight by wrapping around the threads a length of brass wire cloth of from 60 to 80 mesh. This should be daubed freely with litharge or red lead.—F. N. C.

Amplions chosen to reproduce Papal Ceremonies

throughout Saint Peters, Rome



His Holiness the Pope seated on his throne upon the occasion of the recent canonization of Sister Teresa. The microphone is on the right arm of the throne.

Of ALL loud speakers, Amplions enjoy the honor and high compliment of having been installed throughout the famous Cathedral of Saint Peters, Rome, that important ceremonies conducted by His Holiness the Pope may be clearly audible to great multitudes of people.

Supreme clarity of reproduction was the prime requisite. It is only logical that The Amplion—creation of the actual originators and oldest makers of loud speakers—should have been chosen. Amplions outsell any other loud speaker throughout the world, chiefly because of unrivaled clarity of tone. "The clearness of the reproduction of the Pope's voice was an outstanding feature," writes a witness to the first ceremonies. Hear The Amplion in comparison with any or all other reproducers. Prove to your entire satisfaction that it is the 'world's finest loud speaker'. Amplion Loud Speakers, \$12.00 up. Phonograph units in two sizes. Write for interesting literature and dealer's address.

THE AMPLION CORPORATION OF AMERICA

Executive Offices: Suite M, 280 Madison Ave., New York City

Canadian Distributors: Burndept of Canada, Ltd., Toronto

Alfred Graham & Co., London, Eng., Patentees

AMPLION

The World's Standard Loud Speaker



A portion of the magnificent canopy over Saint Peter's Tomb, showing two of many Amplions installed for amplifying Papal services to vast assemblages of pilgrims.

SEND NO MONEY

2 Genuine Diamonds 4 / 100 Each

Cut Stones, No Chips

Solid Gold

\$25

Terms if desired
(6 mos. to Pay)

Outside U. S. cash with order

14 kt. White Gold Top, Gold
Framing (any Lodge) or any
Initial (Old English), Yellow
or White Gold, Inlaid in
Genuine

HOPE RUBY

Also, in Black Onyx

Send size of finger and ring
will be sent for inspection.

Send for Free Catalog

Buffalo Jewelry Mfg. Co., "The Mail Order House"
Dept. A 501 Washington St.



New 6132

This Reg. Trade Mark
guarantees you genuine diamonds.

Send for Free Catalog

Buffalo Jewelry Mfg. Co., "The Mail Order House"
Dept. A 501 Washington St.

NEW VEST POCKET ADDING MACHINE

ADDS • SUBTRACTS

MULTIPLIES • DIVIDES

Does all the work of a \$300.00 machine,
yet fits the vest pocket. Easy to operate
—does any kind of figuring in a jiffy. The
neatest and best constructed portable adding machine made.

Counts Clear Up to 999,999,999

Total visible at all times. A pull of the finger clears it.
Invaluable to anyone who uses figures. Saves many times
its cost by preventing mistakes.

10 Days' Trial Send no money.

Just name and
address and we will send machine post-
paid. Pay postman on delivery \$2.95. Use it
10 days to prove it does all we claim. Your
money back if not perfectly satisfied. Don't
be fooled by cheap imitations. Order your
Ve-Po-Ad now from this ad.

Reliable Adding Machine Corp., Dept. 157
184 W. Washington St., Chicago, Ill.

Here's a money maker. Everybody wants
one. Splendid profit. Write for special offer.

AGENTS

21 JEWEL
Santa Fe SPECIAL
On Credit



No Money Down

Sent On Approval

We will send this famous watch direct to you, express prepaid on FREE approval. Examine watch and be convinced it's the best watch buy you ever saw. You save 1-3 to 1-2 your money by purchasing a Santa Fe Special Watch. We trust you—Wear watch while paying for it.

SEND FOR FREE WATCH BOOK
 Clip the coupon, fill out and receive the FREE WATCH BOOK. All the newest watch case designs in white or green gold, fancy shapes and thin models are shown. Read our easy payment offer. Select the watch you would like to see, we will send it to you on approval, express prepaid. Wear the watch 30 days FREE—return at our expense if not fully satisfied. Ask for Santa Fe Ladies' Bracelet Watch folder and Diamond folder.

SANTA FE WATCH CO.

Dept. A-80 Thomas Bldg., Topeka, Kan.
 The Home of the Great Santa Fe Railway.

Santa Fe Watch Co.
 Dept. A-80 Thomas Building.
 Topeka, Kansas.

Please send prepaid and without obligation, your Watch Book Free, explaining your "No Money Down" Offer on the Santa Fe Special Watch.

Name _____

Address _____

Learn Furcraft

Learn by mail, evenings at home
 Make up New Furs and Make Old Furs Like New. Learn Fur Repairing and Cleaning.

Learn our secret processes. Learn glazing, ironing and storage. Big demand, big need in every neighborhood. A wonderful uncrowded field. Investigate.

\$3 an Hour
 IN THEIR SPARE TIME

or a real business now and later a big fur shop. Next month earnings start if you learn now. Men and women equally successful. Tells all about this greatest of Spare Time Money Makers. Big opportunity now in your neighborhood. Be first. Write at once for Free Book and get full details of this money making business. **NORTHWESTERN FUR COMPANY**
 1787 Sunderland Bldg., Omaha, Neb.

Better Shop Methods

Punch and Die Making

(Continued from page 74)

Next, grind and blue one side of the punch. Lay this side on the cutting edge of the die and scribe the outline on the punch. Clamp the punch on the lathe faceplate and bore out the four 1-in. holes, as in Fig. 9, truing up the center punch mark in each case, as for the die. Then cut the stock away either with a metal-cutting bandsaw or a power hacksaw.

In shaping the punch, try to work within .005 in. of the line all the way around. It will pay you to spend time in accomplishing this, because it is much faster than filing. If properly done you need not touch the work with a file.

You now are ready to shear the punch in the die. If you have left .005 in. all the way around and the die is sharp, hard, and of uniform clearance, you should have no trouble in shearing the punch through. Make sure that the punch is going in square and the chips are not choking the die. Use lard oil and patience.

Remove the punch and file more stock off if necessary, rather than run the risk of breaking the die. An arbor press is a good tool for this job.

To file the clearance on the punch, grind one end of a parallel round file back a distance equal to the thickness of the punch pad, making the diameter less by the amount of clearance. In this case the difference is .125 divided by 20, or nearly .007. The thickness of the soft steel divided by 20 equals the clearance. File this clearance on the drill press, as shown in Fig. 7. The file will cut until the ground part touches the punch.

THE punch is hardened and tempered and the back part drawn to a blue in a lead pot, if one is available, because it must be riveted over in the punch pad, as shown in Fig. 8. Riveting is illustrated here because it is the method a machinist most frequently encounters. Bevel the opening in the pad to suit the headed-over portion in the back of the punch. The punch must be a good fit in the pad and stand square. Place the punch in the pad, grip the punch in a shaper vise, see that the pad rests on top of the vise, and rivet the punch over until it fills the bevel in the pad. Grind the punch and pad together until they are flush. Then machine the stripper until the stock steel slides through easily and assemble.

When the shop equipment is limited and there is perhaps only a lathe, shaper, and drill press available, the task is somewhat harder. After the parts are machined and bored in the lathe, as in Fig. 4, the core must be removed by drilling. Lay out the die as in Fig. 10, using the layout tool shown, which scribes a circle and also makes a slight center punch mark, which can be enlarged if desired.

After the holes are drilled, you have a jig for spotting the layout on the punch pad, stripper, and shoe. After these are

(Continued on page 141)

Relieve the Pain Prevent Infection

Use Absorbine, Jr. 'the magic bottle' to heal cuts, bruises, burns, rash, skin eruptions and to reduce swelling. It's a safe, powerful and effective antiseptic liniment.

\$1.25 a bottle at your druggist's
 W. F. YOUNG, Inc., Springfield, Mass.

Absorbine Jr.
 THE ANTISEPTIC LINIMENT



IT COST MONEY TO FORGET!

Whether it is in the Kitchen, Office, Studio, School Room or Factory.

We can supply you with the reliable, well made and guaranteed **Hawkeye Reminder Clock** that is "watchful of the time." Easily set to one, three or ninety minutes and rings exactly on the minute when time is up. Prevents forgetting, and thereby saves Time, mind and money. Handy size, gray enamel finish, hangs flat against wall or sets on table. Reasonable price.

HAWKEYE CLOCK COMPANY
 Muscatine, Iowa. Distributors Wanted

CONN BAND INSTRUMENTS
 WORLD'S LARGEST MANUFACTURERS

EASIER playing qualities of Conn instruments, the result of exclusive Conn processes, speed your progress, give you quickly the pleasure and profit of personally played music. Used and endorsed by the world's greatest artists.

FREE TRIAL: Easy payments on any instrument for band or orchestra. Send today for catalogs and details; mention instrument.

C. G. CONN, Ltd.
 1013 Conn Bldg., Elkhart, Ind.



ROBERT E. CLARK
 Trombone Soloist
 U. S. Marine Band
 uses a Conn.

EXAMINE FREE Startling Cash Diamond Offers

This guaranteed 3/4 less 1/16 ct. genuine diamond at a low price none can beat—\$68.50. A solitaire of big blaring brilliancy in handsome ring. Has guaranteed loan value \$53. A fraction of Market Price. This or any of hundreds of equally big diamond bargains sent for absolutely free examination at our risk.

A Fraction of Market Prices
 This 75 year oldest, largest, rated over \$1,000,000.00 Diamond Banking firm in all the world lends money on diamonds. Thousands of unpaid loans and other bargains. Many from big cash deals direct with European diamond cutters. Must sell now.

JOS. DE ROY & SONS,
 Only Opposite Post Office

Latest List—Unpaid Loans
 Free Bulletin lists diamonds for cash, low as \$60 per carat. Not all, some of finest quality at low bargain prices. List tells of guaranteed loan values, gives complete descriptions—exact weight, color, quality. List is free. Write today.

4737 De Roy Building
 Pittsburgh, Pa.

LAW Personal Instruction
 By Mail Be a lawyer or law-trained business man. Qualify to earn \$2,500.00 to \$15,000.00 a year. University methods. TUITION LOW. EASY TERMS. Textbooks furnished. Practical and authoritative non-resident course. Endorsed by bench and bar. Prepared for bar or business. Over 60,000 students. PERSONAL INSTRUCTION. Guarantee to coach free any graduate failing to pass bar exams. SPECIAL REDUCED TUITION OFFER now in force. Write today for particulars and book on law FREE.

AMERICAN CORRESPONDENCE SCHOOL OF LAW
 Dept. 1367 3601 Michigan Avenue, CHICAGO

Learn Write
 Begin Today—Write for my FREE BOOK, I can make a good penman of you at home during spare time. Write for my FREE BOOK, "How to Become a Good Penman." It contains specimens and tells how others mastered penmanship by the Tamblin System. Your name will be elegantly written on a card if you enclose stamp to pay postage. Write today for book.

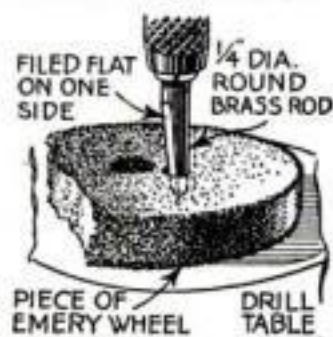
F. W. TAMBLIN, 637 Ridge Bldg., Kansas City, U.S.A.



Better Shop Methods

Drilling an Emery Wheel with a Brass Rod

"COULD you drill a hole in an emery wheel with a brass rod?" a tool-maker asked me the other day. I told him that I did not believe it possible. He took a short length of $\frac{1}{4}$ -in. rod, filed it as shown, put it in a drill press



Piercing a hard grinding wheel

at high speed, and drilled a hole through an old emery wheel about $\frac{1}{2}$ in. thick in almost no time. He did the same stunt with cold-rolled steel, and even a wire nail may be used.—S. L. ROBERTS.

Punch and Die Making

(Continued from page 140)

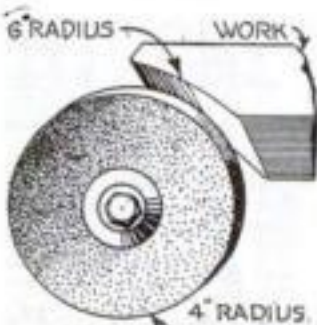
drilled, remove the core by cutting away the bridge with the broach shown in Fig. 10. Then scribe the outline of the templet on the punch pad, stripper, and shoe. These now are ready to be filed. The lines should be split as nearly as possible on the die and punch pad, but the stripper and shoe should be a trifle larger for clearance.

The filing can be done with assurance by a mechanic who has had little experience in this class of work by the method illustrated in Fig. 11. A hardened and ground parallel strip and a piece of hardened drill rod, both of which have the $\frac{1}{2}$ -deg. taper, as shown in Fig. 11, are required. These file guards are placed so that they split the scribed outline on the die. They are made fast with a few drops of solder. An old saw blade is used as a safety guard, as indicated, to prevent the file edge from touching a part already finished.

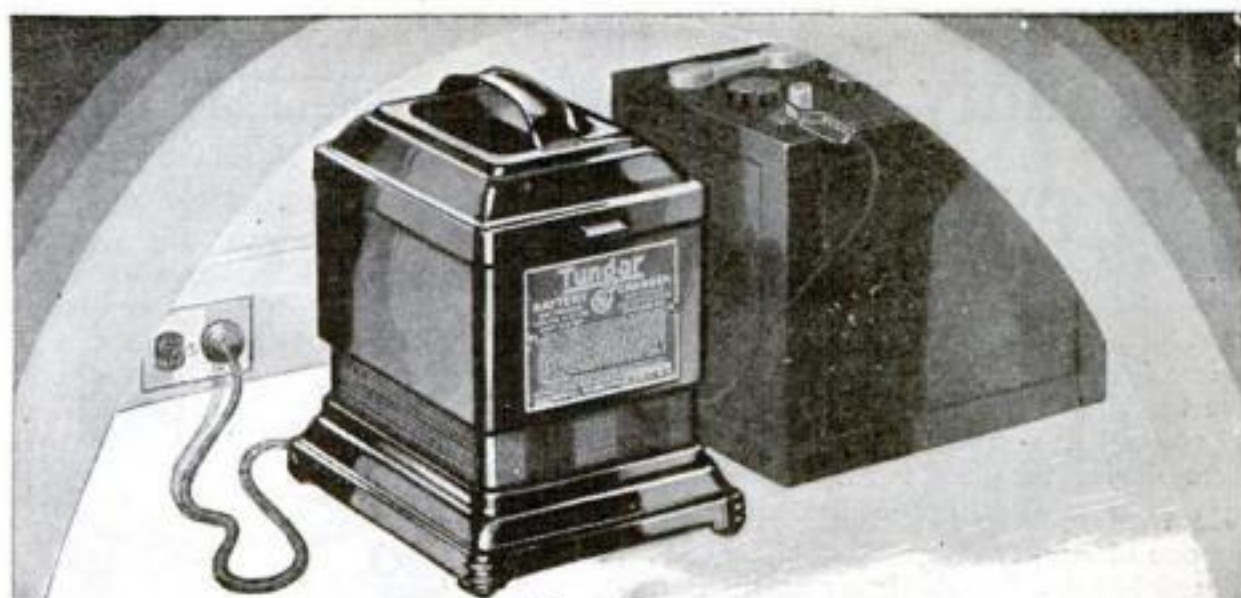
The four parts are finished in this manner and the punch is made as previously described.

Grinding a Radius Larger than the Wheel Available

ANY one who has tried to grind an accurate radius forming tool when the wheel available was smaller than the required radius, will appreciate the method suggested in the accompanying illustration. By tilting the grinder table to an angle that is found by the cut-and-try method and grinding on the edge of the wheel as shown, I have ground tools to a templet with sufficient accuracy to pass an inspector.—K.C.



Among the articles scheduled for forthcoming issues are "The Shipshape Toolroom," "Methods of Repairing Gears," and "An Improved Combination Boring-Tool."



Partners for Power

If you want distance and clear tone from your radio set, your storage battery must have its partner—the Tungar Battery Charger.

Two clips and a plug to connect to the house current. That's all there is to it. Or you can make permanent connection and *just throw a switch*.

The Tungar charges while you sleep—it makes no disturbing noise—keeps your batteries at top notch. For power there is nothing like a good storage battery—with a Tungar to keep it good.



The Tungar is a G-E product developed in the great Research Laboratories of General Electric.

The new Tungar charges 2, 4, 6 volt "A" batteries; 24 to 96 volt "B" batteries, in series; and auto batteries, too. No extra attachments needed.

Two ampere size (East of the Rockies) . \$18.00

60 cycles—110 volts

Tungar
REG. U. S. PAT. OFF.
BATTERY CHARGER

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

Merchandise Division
General Electric Company, Bridgeport, Conn.

GENERAL ELECTRIC

WANTED

RAILWAY POSTAL CLERKS

\$1900 to \$2700 Year

City Carriers—Postoffice Clerks

Postal Salaries Just Raised

TRAVEL—See your country

MEN—BOYS, 18 UP

SHOULD MAIL COUPON IMMEDIATELY

Steady work. No layoffs.
Paid Vacations.



FRANKLIN INSTITUTE,
Dept. G-276, Rochester, N. Y.

Sirs: Send me without charge, (1) Specimen Railway Postal Clerk Examination questions; (2) Schedule showing places of coming U. S. Government examinations; (3) Free sample coaching.

Name.....

Address.....

An old-timer sets a quantity pace for pipe-smokers

Here is a remarkable letter from an old-time traveling man in Seattle who says he has smoked five-eighths of a ton of Edgeworth during the past twenty-four years.

He tried to keep his identity a secret. But one of our scouts tracked him down, induced him to sign the letter and permit its publication, on condition that his name would not be mentioned.

Larus & Bro. Co. Seattle, Wash.
Richmond, Va.

Gentlemen:

I have smoked a pipe for about forty-four years. In 1900 I read a report issued by some Federal Bureau in which it gave a rating of pureness of nearly all the then best known smoking tobaccos. If my memory has not played me a trick Edgeworth stood at the head of the list. I was sufficiently interested to try a can of Edgeworth. Since that time I have smoked nothing but Edgeworth, and when I tell you that I buy a one pound can every week, or fifty-two pounds a year, sometimes more, you will surmise that I am some pipe fiend.

A pound of tobacco per week for twenty-four years makes twelve hundred and forty-eight pounds of Edgeworth, five-eighths of a ton.

The reasons for my loyalty to Edgeworth are these:

It is always the same. Another reason is that Edgeworth is sold everywhere. This letter is not for publication, but just intended as a notification that you have a few inveterate smokers scattered over the country who smoke Edgeworth because they believe it to be the best tobacco on the market.

I have purposely cut off the business heading of this paper and will just sign myself Yours very truly,
"A qualified judge of smoking tobacco."

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever you buy it, for it never changes in quality. Write your name and address to Larus & Brother Company, 10 J South 21st Street, Richmond, Va.



Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidor holders holding a pound, and also in several handy in-between sizes.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

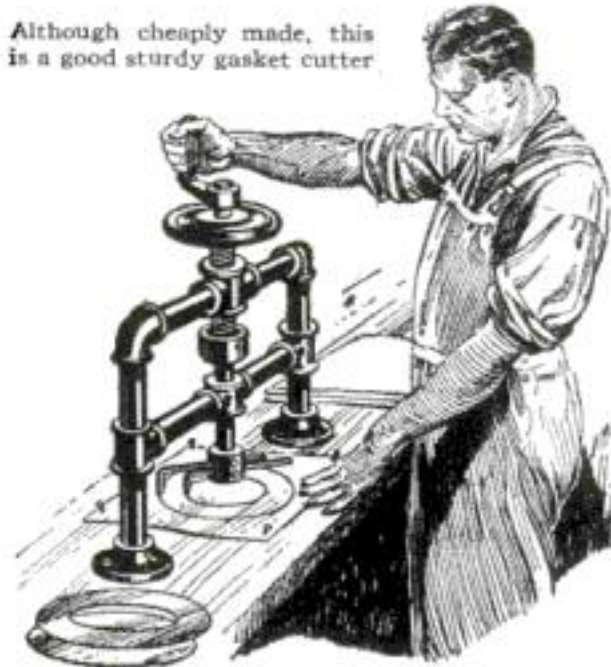
Better Shop Methods

Gasket Cutter Made Cheaply from Pipe and Fittings

By Frank N. Coakley

STEAM-FITTERS and pipe-fitters generally need a cutter for preparing gaskets, as the jack-knife method is slow and unsatisfactory. When a commercial

Although cheaply made, this is a good sturdy gasket cutter

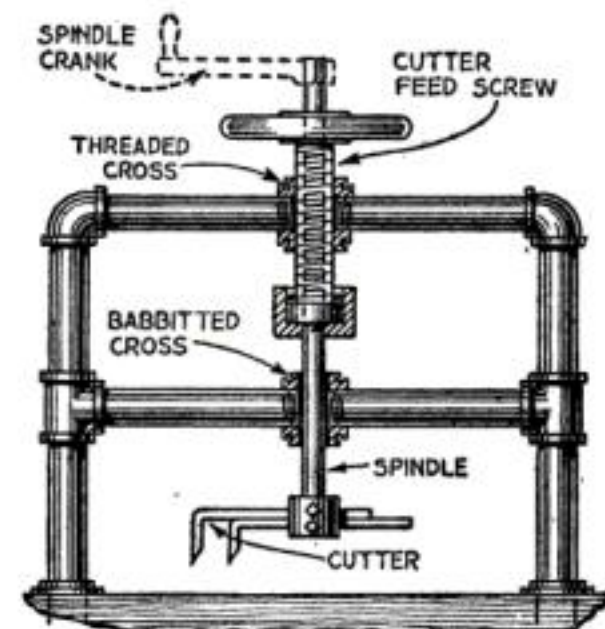


cutter is not at hand, a substitute can be made from standard, easily obtained parts.

The frame is made as shown, from standard 1½-in. pipe and pipe fittings. It is fastened to the workbench with pipe flanges.

The feed screw is a piece of the same size pipe threaded the full length. A common valve wheel is fastened to the top of the feed screw. Attached to the lower end of the screw is a collar, which acts as a pull-back for the cutter spindle. A 1½-in. pipe cross serves as the nut for the feed screw.

The driving spindle is made of cold-rolled steel large enough to fit snugly within the feed screw. A cup-shaped



The cutter spindle passes through the feed screw, which is a threaded length of 1½-in. pipe

washer is pinned to the spindle so as to fit over the collar on the screw. Two pins, one each side of the screw, are forced through holes in this collar, as indicated. The middle cross is babbitted to suit the spindle.

The cutter head is made from round stock with holes for the cutters and setscrews. The end of the spindle is squared to receive a crank.

THAT WET BOILER PIT CAN BE MADE DRY!

MAKE and keep your cellar walls, floor and boiler and drain pits thoroughly dry by filling the cracks and coating the surface with Smooth-On No. 7, the only practical waterproofing material that can be effectively applied from inside and bonds perfectly on wet or dry surface. Excellent also for patching concrete floors, waterproofing garage, stable and wash-room floors, brick walls, cisterns, septic tanks, water troughs, fountains, fish ponds, swimming pools, manure pits, etc.



Write for FREE BOOK

The pit shown at the bottom of this advertisement was below the sewer line and leaked so badly that it usually contained from 6 to 12 inches of water. Since coating the walls and floor with Smooth-On No. 7 the pit remains absolutely dry and gives no more trouble.

Waterproofing the concrete cellar floor and walls with Smooth-On No. 7 improves sanitary conditions, removes damp and musty odors, protects valuable tools from rusting, and makes the cellar a clean wholesome place for storing jams, jellies, food, etc.

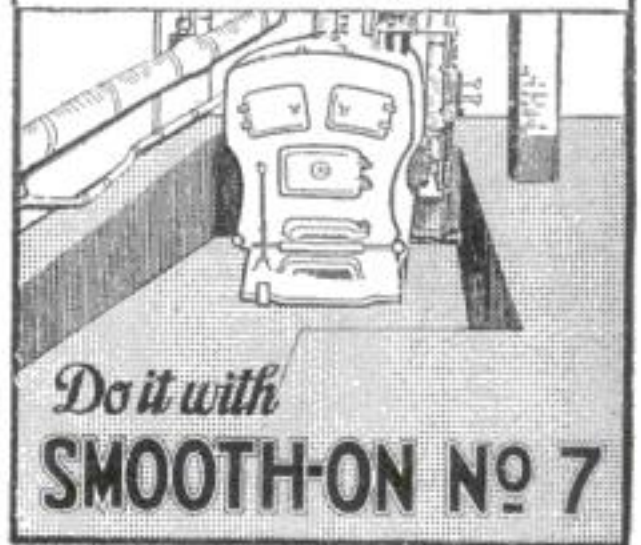
Requires about 25 lb. Smooth-On per 100 sq. ft. of surface and you can do the work yourself.

Sold in 5 and 10-lb. cans and 25, 50 and 100-lb. kegs

SMOOTH-ON MFG. CO.

Dept. 60

574 Communipaw Avenue
JERSEY CITY, N. J.



LAW STUDY AT HOME

Become a lawyer. Legally trained men win the highest positions and biggest success in business and public life. Be independent. Greater opportunities now than ever before. Big corporations are headed by men with legal training. Law trained men earn \$5,000 to \$10,000 Annually. We guide you step by step. You can train at home during spare time. Degree of LL. B. conferred. LaSalle students practicing law in every state. We furnish all text material, including fourteen-volume Law Library. Low cost, easy terms. Get our valuable 100-page "Law Guide" and "Evidence" books free. Send for them NOW.

LaSalle Extension University, Dept. 1083-L Chicago
The World's Largest Business Training Institution

Learn Aviation

Take a W. A. C. Course in Applied Airplane Engineering. Many men earn \$2000 to \$10,000 a year. Big Free outfit of airplane parts. Write for Free catalog.

WESTERN AIRPLANE CORPORATION
Dept. P-10 Bensenville, Ill. Chicago, Ill.



Must Men Fear 40?

MEDICAL authorities agree that 65%, or nearly two-thirds, of all men past middle age, are afflicted with a disorder of the prostate gland. Here is the known cause for many of the ailments commonly ascribed to declining years—including aches in back, feet and legs, frequent nightly risings, sciatic pains, nervousness and lack of vitality. But now, science knows that thousands suffer needlessly.

For a well known American Scientist has discovered a remarkable new drugless hygiene that usually restores the prostate gland to its normal functioning. Already it has been used by more than 15,000 men—Doctors, Statesmen, Teachers, Bankers, Lawyers, men in every walk of life—with amazing results.

FREE BOOK

If you will mail the coupon below, you will get, in plain wrapper, a free copy of an interesting book describing this new method. It contains facts every man should know. But send immediately, for the edition of this book is limited: address:

THE ELECTRO THERMAL COMPANY
4050 Main Street, Steubenville, Ohio.

Please send me Free, and without obligation, a copy of your booklet, "Why Many Men Are Old at 40." Mail in plain wrapper.

Name.....

Address.....

City.....State.....

Western Office—Dept. 40-Q, 711 Van Nuys Bldg.,
Los Angeles, Cal.

Better Shop Methods

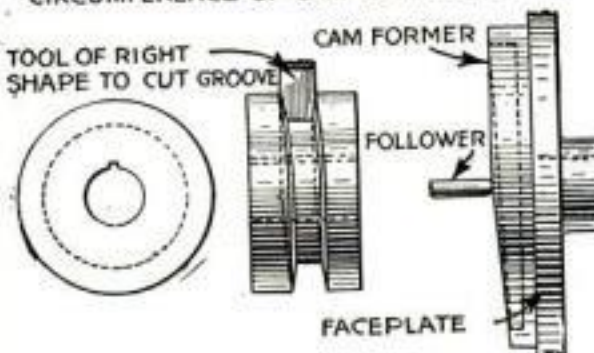
How to Fit Up a Lathe to Cut Small Cams

IN MANY small shops where there is not sufficient work to warrant the expense of a special cam-cutting machine, it sometimes is necessary to produce a cam by some makeshift method. The lathe is well adapted for cutting a variety of cams and can be fitted up for that purpose with little expense.

As an illustration of how this class of work may be done on the lathe, the cylinder cam illustrated is a good example. In this case a flanged plate is made, with the outer face conforming to the cam itself. It is a master cam and produces the same motion. This plate or master



CIRCUMFERENCE OF CAM DEVELOPED



Diagrams showing typical cam and method of using a forming plate or master cam

cam is bolted to the faceplate of the lathe and a follower, attached to the lathe carriage, bears against it. A spring or weight also is attached to the carriage by any convenient method to insure a uniform contact and exert sufficient pressure against the plate to overbalance the pressure of the cut.

The cam blank is mounted on an arbor that is driven with a dog. A tool of the right shape is made for the groove. This is fed in slowly by hand to the proper depth. The tool should have sufficient side clearance so that it will not drag or tear the metal.

A great variety of cams can be produced by this method and in many cases the time required for making them will compare favorably with special cam-cutting machines.—J. A. HORTON, Sebring, Fla.

Small Fillet Tool for Lathe

SERVICEABLE fillet tools can be made quickly and cheaply as illustrated. A piece of machine steel $\frac{5}{8}$ by 1 in. is used for the shank; the cutting point is made of drill rod. The end of the shank is grooved to receive the drill rod.

Cut a short piece of the rod and bevel one end to give it the proper rake and clearance angle. After hardening and tempering it, fasten it to the shank with solder. Build a bank of solder well up in back of the point and along the edge on each side.—H. L. W.



Keep fit to Music



Free!

This 64 page book tells about the various models, with pictures of professionals using them. Send coupon or postal for your free copy.

When the baseball season is over, Benny Bengough, star of the New York Yankees, keeps fit and makes big money playing the Buescher Saxophone with Harold Oxleys Orchestra. Summer and winter he's the center of attraction, always in perfect condition.

Play Jazz In 10 Days

The lure of jazz is yours with a Buescher True-Tone Saxophone. Young folks are enraptured by these tantalizing tunes. They love that syncopation. If you want to be popular—if you want to be admired—favored, get this wonderful instrument. At home, at parties, everywhere, the Saxophone player is the center of attraction.

See How Easy It Is

Everyone has a perfectly normal desire to produce music, yet most people have not the time nor patience to become a musician. But a

277

BUESCHER True Tone SAXOPHONE

is different. It looks complicated, but is really very easy to play. With the aid of three free lessons, the scale can be mastered in an hour; in a few days you can be playing jazz tunes. Practice is a pleasure because you learn to play so quickly.

Buescher Grand Trumpet

Especially easy to blow, with an improved bore and new proportions. With the mute in, it blows so softly and sweetly that practice never annoys.

Six Days Free Trial, Easy Payments

Send for a Buescher Saxophone or a Cornet, Trumpet or Trombone for six days free trial in your own home. Send no money. If you like the instrument pay a little each month. Clip the coupon now for your free copy of the beautiful Saxophone Book or catalog of any instrument. No obligation whatever. Do it today. Now.

BUESCHER BAND INSTRUMENT CO.

Everything in Band and Orchestra Instruments
970 Buescher Block Elkhart, Indiana

Clip the Coupon NOW!

Mail BUESCHER BAND INSTRUMENT CO.
970 Buescher Block, Elkhart, Indiana
Without obligation to me, send book "The Story of the Saxophone". Check here ☐
If you prefer other literature describing other band or orchestra instruments, check below.
Cornet ☐ Trumpet ☐ Trombone ☐ Tuba ☐
Mention any other.....
Write plainly, Name, Address, Town and State in Margin Below

LOFTIS BROS. & CO. ESTD 1888

DIAMONDS WATCHES

CASH or CREDIT

SEND FOR CATALOG
Over 2,000 bargains in Diamond-set Jewelry, Watches, etc. Sent prepaid for your FREE Examination. Catalog explains everything. Money back if not satisfied.

No. 27
Dazzling, Blue White perfect-cut Diamond. Solid 18-K White Gold. Price \$140. Pay \$10 down, then \$2.50 a week.

WRIST WATCH
18-K Solid White Gold, 17 J. \$27.50
14-K Solid White Gold, 16 J. \$22.50

High-Grade Railroad Watches
Guaranteed to Pass Inspection

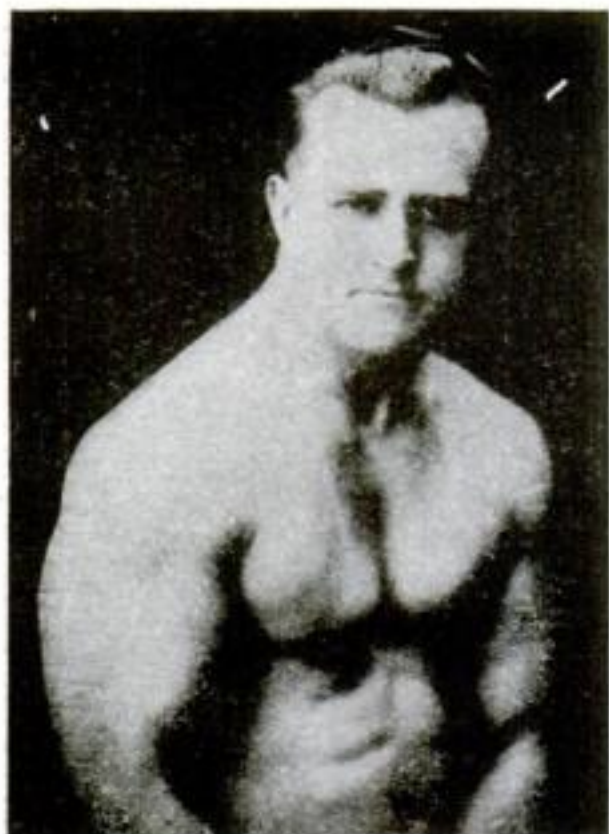
HAMILTON No. 992, 21 Jewels, Adjusted to 5 Feet—\$55
100% Gold filled 26-Year Case

ELGIN'S LATEST RAYMOND, 21 Jewels, 8 Adjust—\$55
100% Gold filled 26-Year Case

Delivered on first pay—\$1.00 a Week
Month of \$5.50, then \$1.00 a Week

LOFTIS BROS. & CO. National Jewelers
Dept. E571 108 N. State St., Chicago, Ill.
Stores in Leading Cities

RADIO FANS—Listen in on W. H. T. every Friday night from 7:30 to 10. Central Standard Time. Loftis Bros. & Co.'s hour of music.



EARLE E. LIEDERMAN

The Muscle Builder

Author of "Secrets of Strength," "Here's Health," "Science of Wrestling," "Muscle Building," etc.

—And the Best Man Won!

Crack! His fist landed squarely behind the bully's ear and down he fell in a heap. Quick as a flash he turned to face the other hold-up man who, with fist closed, was right on top of him. Another thud and another limp form lay on the ground. Quivering with tense excitement, he stood over the two prostrate figures waiting for them to get up. But they did not move. Both were knocked cold. Smilingly his sweetheart came toward him and, patting him on the arm, she said: "I am proud of you, but I knew you could do it." A small crowd gathered. Admiring and envious eyes watched the young man and his sweetheart as they slowly moved away. Even the policeman who had arrived on the scene was loud in his praise.

HOW DID HE DO IT?

"I can thank Earle Liederman for that," was his first remark as they walked away. "Six months ago I would never have dared to face one man, and certainly not two at the same time. That system of his sure did put me in fine physical shape. Now I am ready for anything and I never know what it is to be afraid. The bigger they are the harder they fall."

WHAT WOULD YOU DO?

Suppose someone tried to bully you, would you run away? Do you possess the muscular development and the courage that goes with it to resist an insult? What would your wife or sweetheart think if they found you played the part of a coward in a circumstance like the above? There is no excuse for it. Any man may now fortify himself and

BE PREPARED

to cope with any such emergency. I can take that body of yours and in 30 days I will add one full inch of muscle to your arms. I will add two inches to your chest at the same time. But that's just a starter to show what I can do. I give you not only muscular arms, massive legs, deep chest and broad back, but I strengthen every muscle in and around your vital organs. My system is progressive. I work on every muscle in your body. I'll make a he-man of you. I'll fill you full of vitality and pep. I'll put a spring in your step and a flash in your eye. I'll give you the courage that goes with a perfect functioning, muscular body. You won't know what fear means. I'll make people stare at you and say, "There goes a big two-fisted he-man." Come on boys, let's get started. Don't waste time. Right now, before you turn this page,

Send for My New 64-Page Book
"MUSCULAR DEVELOPMENT"
It is FREE

It contains forty-eight full page photographs of myself and some of the many prize-winning pupils I have trained. Some of these came to me as pitiful weaklings, imploring me to help them. Look them over now and you will marvel at their present physiques. This book will prove an impetus and a real inspiration to you. It will thrill you through and through. All I ask is 10 cents to cover the cost of wrapping and mailing and it's yours to keep. This will not obligate you at all, but for the sake of your future health and happiness, do not put it off. Send to-day—right now, before you turn this page.

EARLE E. LIEDERMAN

Dept. 1310 305 Broadway New York City

EARLE E. LIEDERMAN

Dept. 1310, 305 Broadway, New York City

Dear Sir:—I enclose herewith 10 cents, for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development." (Please write or print plainly.)

Name

Street

City

State

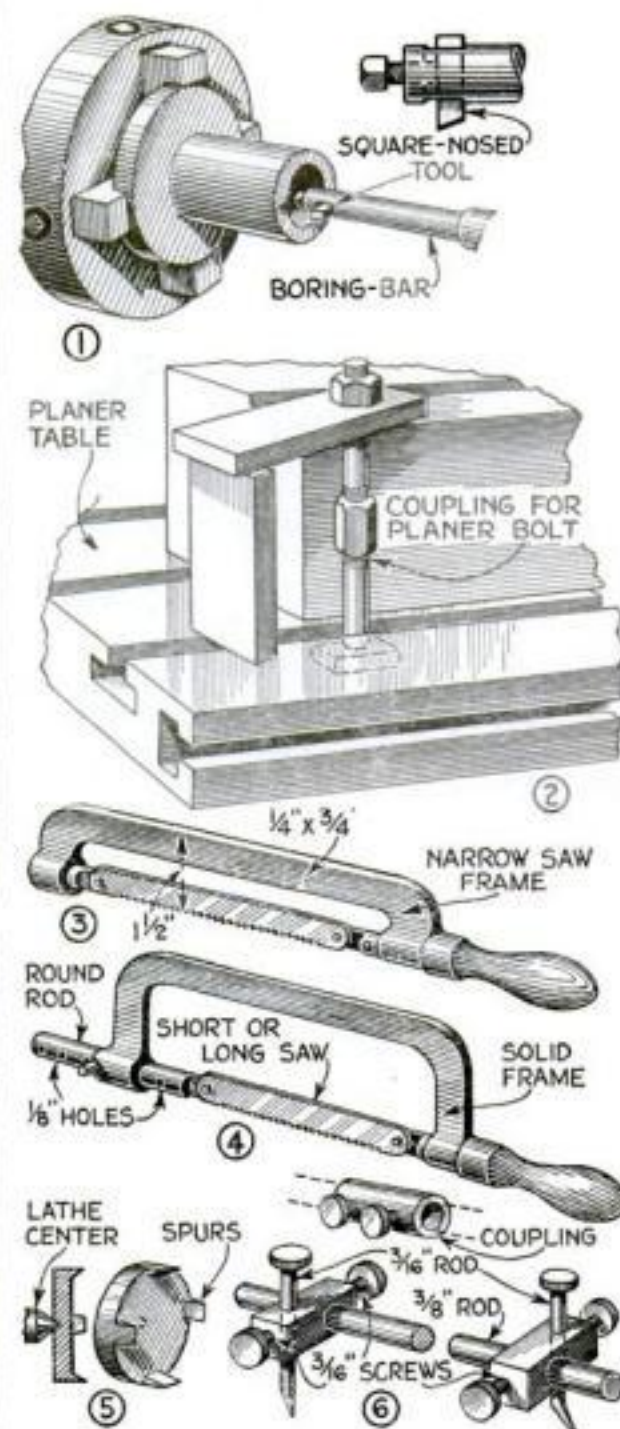
Better Shop Methods

Doing Things the Easiest Way in a Machine-Shop

By E. C. Fellows

KEYSEATS in small holes through long hubs sometimes can be cut with a boring-bar in the lathe more efficiently than by taking them to a keyseater or shaper. A square-nosed tool is put in the boring-bar for this purpose, as shown in Fig. 1. The carriage is moved back and forth by hand, while the depth of cut is adjusted by the cross-feed screw.

A few long nuts, or bolt couplings, are a useful addition to the shop's supply of planer bolts. With a stock of rods of varied lengths threaded on both ends, a



Cutting a keyseat in a small, long hub, and five other time-saving shop expedients

planer bolt of almost any length can be made up (Fig. 2). A nut placed in the T-slot serves for a head. The couplings also can be used to extend the regular T-head bolts.

For sawing in close places the narrow hacksaw frame, shown in Fig. 3, cannot be beaten. It is a useful tool for such work as cleaning up the corners of keyseats that have been chipped, and for sawing obstinate bolts in places too small to admit the regular frame. Another hacksaw kink is shown in Fig. 4. A solid

(Continued on page 145)

Squab Book FREE



Squabs selling at highest prices ever known. Greatest market for 20 years. Make money breeding them. Raised in one month. We ship everywhere our famous breeding stock and supplies. Established 24 years. Write now for big illustrated free book. How to Make Money Breeding Squabs. **PLYMOUTH ROCK SQUAB CO.** 616 H St., Melrose Highlands, Mass.

AGENTS 500% PROFIT GENUINE GOLD LEAF LETTERS



Guaranteed to never tarnish. Anyone can put them on stores and office windows. Enormous demand, large profits. Paul Clark says: smallest day \$28.70. R. L. Reel made \$920 in two months. Write today for free sample and liberal offer to general agents.

METALLIC LETTER CO., 433A N. Clark Street, Chicago.



Start a Movie Show

SMALL CAPITAL STARTS YOU. Your opportunity to become independent. No experience needed. We show you how. Our easy payment plan makes it easy to start. We equip you complete. Our machines used and endorsed by government institutions. Write today for free catalog. **ATLAS MOVING PICTURE CO.** 636 E. Dearborn St., Dept. 7, Chicago.



AGENTS

Stamping names on Pocket Key Protectors; sample Check with your name and address, 25c. Stamping Outfits, Emblem Checks, Fobs, Name Plates.

HART MFG. CO.

305 Degraw St., Brooklyn, N. Y.

SELL TO STORES CANDY GUM AND MINTS

40% to 160% Profit

I will put you in business as my DIRECT FACTORY AGENT AND JOBBER, to take orders for my full line of candies, chocolate bars, mints and chewing gum. Unlimited opportunities for hustlers. No experience needed. I furnish everything. Every store and everybody buys. Work spare time or fulltime. Write today for catalog, selling plan and FREE SAMPLES. Exclusive territory. ACT QUICK. **MILTON GORDON, 895 Jackson St., Cincinnati, O.**

TYPEWRITER PRICES CUT

World's best makes—Underwood, Remington, Oliver—prices slashed to almost half. \$2 and it's yours. All late models, completely rebuilt and re-finished brand new. GUARANTEED for ten YEARS. Send no money—big FREE catalog shows actual machines in full colors. Get our direct-to-you easy payment plan and 10-day free trial offer. Limited time, so write today. International Typewriter Ex., 126 W. Lake St., Dept. 1008, Chicago.

Class Rings and Pins

Largest Catalog Issued—FREE. Samples loaned class officers. Prices \$2.20 to \$8.00 each. No order for class, society or club emblems too large or too small. Special designs made on request. **CATALOG FREE**

METAL ARTS CO., Inc., 7706 South Ave., Rochester, N. Y.

30 Days' Free Trial

Select from 44 Styles, colors and sizes, famous Ranger bicycles. Delivered free on approval, express prepaid, at Factory Prices, from \$21.50 up. \$5 a Month. If desired, Parents often advance first deposit. Boys can earn small payments. wheels, lamps, horns, equipment at half usual prices. Send No Money. Write for our marvelous prices and terms.

Mead CYCLE COMPANY Write us today for free catalog
DEPT. A-250 CHICAGO

SEND FOR THE INTERNATIONAL CATALOG

Our net price list Full line of auto bodies and accessories for Ford at Wholesale Prices. Save big money on bodies by buying Direct from Factory.

FOR FORD—Prices from \$27.85 up. Factory to consumer direct—Pay only One Profit International Body Works, 914 W. Ohio St., Dept. 8, Chicago, Ill.

FREE!

12-Cell — 24-Volt Storage 'B' Battery

Positively given free with each purchase of a WORLD "A" Storage Battery. You must send this ad with your order. WORLD Batteries are famous for their guaranteed quality and service. Backed by years of successful manufacture and thousands of satisfied users. Equipped with Solid Rubber Case, an insurance against acid and leakage. You save 50 per cent and get a

2-Year Guarantee

Bond in Writing WORLD Battery owners "tell their friends." That's our best proof of performance. Send your order in today.

Solid Rubber Case Radio Batteries
 6-Volt, 100-Ampere . . . \$11.25
 6-Volt, 120-Ampere . . . 13.25
 6-Volt, 140-Ampere . . . 14.00

Solid Rubber Case Auto Batteries
 6-Volt, 11-Plate . . . \$11.25
 6-Volt, 12-Plate . . . 13.25
 12-Volt, 7-Plate . . . 16.00

Send No Money Just state battery wanted and we will ship day order is received, by Express C. O. D. subject to your examination on arrival. **FREE "B"** Battery included. Extra Offer: 5 per cent discount for cash in full with order. Buy now and get a guaranteed battery at 50 per cent saving to you.

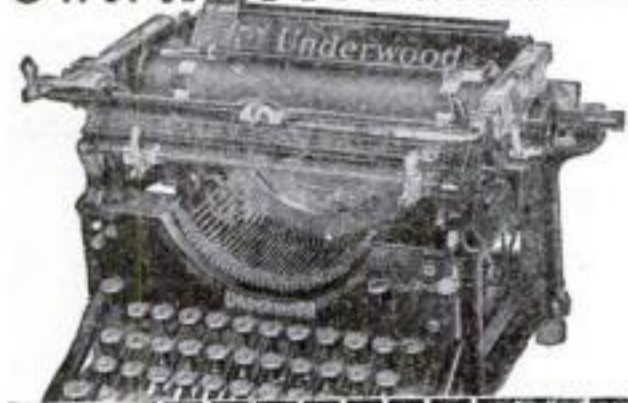
WORLD BATTERY COMPANY
 1219 So. Wabash Ave., Dept. 7 CHICAGO, ILL.

World STORAGE BATTERIES

Set your Radio Dials at 210 meters for the new 1600 watt World Storage Battery Station, WBB, Chicago. Watch for announcements.

INDIA - WFAF - WGN - WJS - KHJ - KGO - KFAF - WJY - KOF

OWN A TYPEWRITER



\$3 and it's yours
 if you clip this now

The age of writing machines—at a bargain price! A free trial, and easiest monthly payments if you buy! This Underwood No. 5—rebuilt from top to bottom—five-year-guaranteed—removes the last reason for not owning your own machine. Get our proposition with new and valuable Typewriting Manual, free.

FREE! Typewriting Manual, large catalog, and full particulars of free course in touch writing, if you mail this to SHIPMAN-WARD MFG. Co., 2147 Shipman Bldg., Chicago.

Name _____
 Address _____

Steinite Interference Eliminator

50,000 Sold First 8 Weeks—Every Radio Owner Needs One
Select Station at Will Cut out interference and undesired stations. Tune in loud and clear. Results amazing with any make tube or crystal set using any kind of aerial except loop antenna.
DECREASES STATIC



\$1 POSTPAID!
 Better reception or your money refunded. Bank guarantee.

Assembled complete; attach to aerial in two minutes. No tools. Doesn't disturb present log. No additional tubes or batteries.

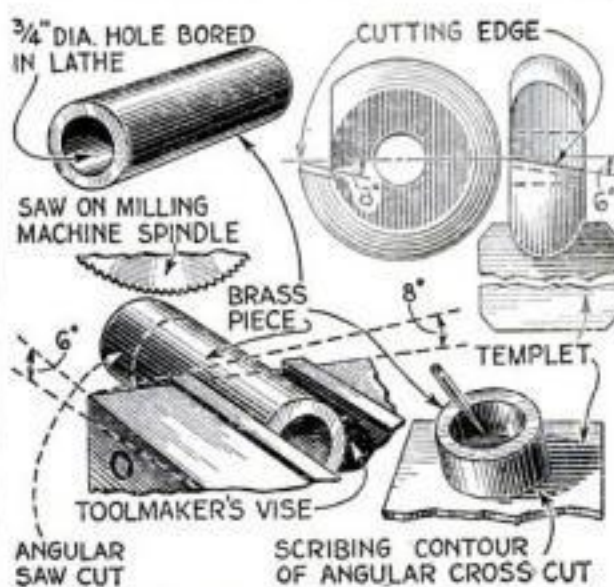
Send \$1 Bill Now away with interference. Complete Radio literature FREE.
STEINITE LABORATORIES, Dept. 400, ATCHISON, KANSAS
DEALERS—JOBBER. Write for descriptive literature and prices. Steinite Nationally known popular price Radio Sets.

Better Shop Methods

Laying Out a Templet for a Circular Forming Tool

WHILE at first glance the circular forming tool illustrated below seems to be of the simplest type, it caused considerable difficulty at one time in a ball-bearing plant where the writer was employed.

When the tool was ground at angles of 6 and 8 degrees for clearance, the finished work was not the perfect $\frac{3}{8}$ -in. radius that was required, but was somewhat elliptical. The engineer in charge tried to draw a layout for a templet to be used in grinding the tool so that the work would be true,



A brass bar, bored and cut at the proper angle, is used in preparing the templet

but finally he gave it up and told me to grind the tool as best I could, after pointing out the need for absolute accuracy.

I put a piece of round brass in a chuck, bored it out to a diameter of $\frac{3}{4}$ in., put it in a toolmaker's vise set at 6 degrees one way and 8 degrees another, and cut off a piece. The cut end was laid on a piece of sheet metal and a line scribed around its inner contour. A templet then was made by filing up to this outline and the tool ground to suit. The work came out a true $\frac{3}{8}$ -in. radius. I have since used this same method with good results for solving similar problems in the toolroom.
 —HUGO LJUNGQUIST.

Doing Things the Easiest Way

(Continued from page 144)

frame may be made adjustable by adding a rod with holes for a pin at points to suit shorter lengths of blades.

The center shown in Fig. 5 is useful when patterns are to be turned in an engine lathe. It is simply a disk of steel or brass with a 60-deg. center on one side and four teeth to be driven into the wood on the other. This holds solidly and does not tend to split the pattern.

An easy way to make a set of trammel points is illustrated in Fig. 6. The bodies can be made of $\frac{3}{4}$ -in. key steel, the bar of $\frac{3}{8}$ -in. drill rod, or cold-rolled steel, and the points themselves of $\frac{3}{16}$ -in. stock. The points are either ground eccentric or bent, to permit of fine adjustments by turning the point in the body. The coupling is added so that the rod may be in sections short enough to go in the toolbox.



**Couldn't Play a Note —
 Now Makes \$100⁰⁰ a Week**

"When I sent for your catalog, I didn't know a note of music. A few months after I bought my Wurlitzer instrument, I had taken my place in a professional orchestra. Now I am making \$100 a week, three times what I made as a clerk. I wish everybody knew how easy it is—anyone who can whistle a tune can learn to play a musical instrument."—Bill Carola.

Free Trial—Easy Payments

You may now have any Wurlitzer instrument for a week's free trial in your own home. Examine the instrument, note the fine workmanship, the full, rich tone value and especially how easy it is to play. No obligation to buy—no expense for the trial. We make this liberal offer because we want you to try for yourself a genuine Wurlitzer instrument, the result of 200 years' experience in musical instrument building.

Easy payments are arranged to suit your convenience. This is your opportunity to try a famous Wurlitzer instrument in your own home.



Send for Free Book

Illustrates and describes every known musical instrument—more than 3000 articles, many of them shown in full colors. All genuine Wurlitzer instruments—buy direct from Wurlitzer and save money. Special offers on complete outfits. We also give you our Free Trial, Easy Payment Plan. No obligation.

Send Coupon Today!

Send this Coupon

The Rudolph Wurlitzer Co., Dept. 1787
 117 E. 4th St. Cincinnati 329 S. Wabash Ave. Chicago
 120 W. 42nd St. New York 250 Stockton St. San Francisco
 Send me your Free Book on musical instruments. Also your Free Trial, Easy Payment Plan. No obligation.

Name _____

Address _____

City _____ State _____

Instrument _____

WURLITZER

Copyright 1925, The Rudolph Wurlitzer Co.

Money Making Opportunities for "Popular Science" Readers

Readers of POPULAR SCIENCE MONTHLY will find scores of opportunities in this section (pages 146 to 174) for making more money.

Come Out of the Fog And Be Happy!



REMEMBER, THERE IS NO SUBSTITUTE FOR PERSONAL TRAINING, IN GREAT SHOPS, ON COMPLETE ELECTRICAL APPARATUS.

You don't need advanced education, knowledge of higher mathematics or experience in order to learn at COYNE.

Earn While You Learn
My Employment Dept. helps you get a job to earn part or all of your expenses and enables you to a good job upon graduation.



— Will Close the Big Gap Between Your PRESENT and Your FUTURE!

Does your present job offer you a FUTURE? If so, how long must you wait for that future? Five?—ten?—fifteen?—perhaps twenty years? TOO LONG to wait for an uncertainty! Too many things can happen in that time to rob you of the fruits of your hard, earnest labors. GET WHAT YOU EARN—now! Drudging through the years in hopes that mere chance will provide a big future for you is like wandering in a fog with little prospect of reaching your destination.

Get into IMPORTANT work, where your services will be needed, not merely tolerated. The Electrical Field offers Thrills Galore, Wonderful Experiences, and SALARIES that any he-man can brag about! COME OUT OF THE FOG AND BE HAPPY—in the Electrical Field!



H. C. LEWIS, President
COYNE Electrical School

HUNDREDS
OF COYNE-
TRAINED
MEN EARN
\$60 TO \$200
A WEEK

COMPLETE ELECTRICAL TRAINING IN 12 HAPPY WEEKS AT COYNE

I have perfected an unusual course of instruction in Electricity, a course that is absolutely thorough, that is easy to master, that covers every single phase and factor of the subject, that fits men for the BIG electrical jobs—the HIGH-SALARIED thrilling jobs.

COYNE does not teach by correspondence, but by practical, personal training in the wonderfully-equipped COYNE Shops, located in Chicago, the electrical center of the world. At COYNE your training is really PERSONAL and PRACTICAL, on the most MODERN and COMPLETE electrical apparatus, under guidance of thoroughly-qualified instructors. You also visit great industrial organizations and power plants.

Tune in on COYNE Radio Station WGES

COYNE ELECTRICAL SCHOOL

H. C. LEWIS, President

Established 1899

1300-10 W. Harrison St. Dept. 1367 Chicago

There is no Substitute for Personal Training,
in Great Shops, on COMPLETE Apparatus

Send For My Big Free Book
and Special Offer of R. R.
Fare and 2 Extra Courses

Surprisingly Large, Handsome and
Complete Electrical Book Costs You
Nothing, Now or Later

I've just printed a great big, handsome, two-color Electrical Book that I want to send you at once. It is 12x15 in size and contains 141 actual photos of electrical scenes and operations. Tells about dynamos, radios, autos, airplanes, farm lighting and power, etc. Nothing like it. You'll be amazed. ABSOLUTELY FREE, REMEMBER.

SEND COUPON NOW

H. C. LEWIS, President
COYNE ELECTRICAL SCHOOL
1300-10 W. Harrison St.
Dept. 1367 Chicago, Illinois

Dear H. C.—You can just bet I want one of those big, handsome 12x15 books, with 141 actual photographs printed in two colors. Send it quick, before the supply is exhausted. Be sure to tell me about Special Offer of Railroad Fare and 2 Big Courses.

Name _____

Address _____

\$100 in CASH PRIZES

Every reader of POPULAR SCIENCE MONTHLY is invited to enter this contest. For the best letters of 100 words or less answering the question—

“What Advertisement in the ‘Money-Making Opportunities’ Department in this issue interests you most—and why?”

we will pay the following prizes

FIRST PRIZE	\$50.00
SECOND PRIZE	25.00
THIRD PRIZE	10.00
FIFTEEN PRIZES OF \$1.00 EACH	15.00

First read every advertisement in the Money-Making Opportunities Section on pages 146 to 174. Pick out the one that interests you most and then write a letter—not exceeding 100 words—telling us why you find the advertisement you have selected the most interesting.

Entries for the contest will close on October 1st. The prize winners and their letters will be published in this section in the December issue.

Address your letter to

Contest Editor

MONEY-MAKING OPPORTUNITIES
POPULAR SCIENCE MONTHLY
250 Fourth Avenue, New York



A Simple Lesson in Arithmetic For Men Who Want More Money

By A. H. WARD

You may think that my arithmetic is funny, but it certainly worked for me. You can add ten and ten in the ordinary way and you'll never get more than \$20—and that's just about what I was earning a week before I left the States for twenty months' active service in France. When I came back I determined that I would not go back to the old grind! I found a way to put one ten alongside of the other so that the total made over a thousand dollars—and that's what I averaged every 30 days for the last twelve months. Through the simple method I'll tell you about I made \$13,500 last year.

THERE'S no reason why any ambitious man should not follow in my footsteps. I read an advertisement, just as you are now reading my story—It told about W. Hartle of Chicago who had been in the R. R. Mail service for ten years. Hartle made a sudden change—against the advice of his friends—and made over \$1000 the first two weeks. Berry of Winterset, Iowa—a farm-hand—made \$1000 the first month. George Kearns made \$523.00 the first two weeks. F. Wynn made \$554.37 the first seven days and Miller, a former stenographer, made \$100 a week after making this change.

Well, man, I sat up and took notice. If they could do these things—ordinary men like myself—I knew that I had a chance. I investigated and found that what the advertisement said was true. Fact is, you can figure it out for yourself in simple logic. Consider these two points.

Easy for Two Reasons

First: There is no money and no future in the routine job. Everyone knows that. If you want to make the real money, you must get into the producing end of the business—be a salesman. Wait, now, don't let the word SALESMAN scare you. For the second thing is this: Salesmanship is governed by rules and laws. It is just like learning the alphabet. And men who always have thought that salesmen are "born" and not made, very quickly learn that there are certain definite ways to approach different types of prospects to get their undivided attention—certain ways to stimulate keen interest—certain ways to overcome objections—batter down competition and make the

prospect act. And any man can learn these simple principles. I know that because I've proved it to myself.

Of course I didn't know it then. The idea just appealed to my common sense or reason or whatever you call it. I sent for the book that Mr. Greenslade, the president of The National Salesmen's Training Association, will send out absolutely free to any man who writes.

This Free Book Started Me

After reading this remarkable book I enrolled. Don't think I'm boasting, I'm just stating facts. Within one year I had averaged over \$1000 a month income—\$13,500 the first year—and in addition was elected as an officer of Post's of Chicago.

Now don't misunderstand me. I don't say that you can do as well. You may not make a thousand dollars the first month. You may not have as much determination to succeed as I had, you may not have the driving force behind your efforts that spurred me on. But I do say that since looking into the matter can't cost you a cent, you should at least investigate. You can't help but benefit and if you're any man at all you should double or triple your income without half trying.

I'm not particularly keen for the publicity this story is giving me. My friends may laugh at me for allowing my picture to be printed here with my name, but I do so anyway because I realize that my story may be instrumental in showing other men a quick, easy way to realize their ambitions and make the dreams of their hearts come true.

Send Today for Free Book

If you really want the good things of life—the things that only money can buy—I urge you to send the request blank on this page to Mr. Greenslade. He will send you Free and without any obligation "Modern Salesmanship," the book that started me on the road to success. Then decide for yourself. Even if you don't go ahead you will be out only two cents. And on the other hand you may find a way to double or triple your salary in a short period. Just mail the attached coupon today with your name and address.

Yours for success,
A. H. Ward.

Written for Mr. J. E. Greenslade, President
National Salesmen's Training Association
56-D N. S. T. A. Bldg., Chicago, Illinois.



National Salesmen's Training Association

Dept. R-15, N. S. T. A. Bldg., Chicago, Ill.

MR. J. E. GREENSLADE, PRESIDENT,
National Salesmen's Training Association,
Dept. R-15, N. S. T. A. Building, Chicago, Illinois

Send me free the book that gave Mr. Ward his start. This does not obligate me.

Name.....

Address.....

City..... State.....



Daring Young Men Needed in Aviation

THERE is no field of work in the world today which offers such amazing opportunities to young men of daring and who love adventure, as does Aviation. Although still in its infancy, there is a crying demand in Aviation for young men with courage, nerve and self-reliance. For those who can qualify there will be thousands of highly paid jobs which will lead quickly and surely to advancement and success.

Big Opportunities Await the Trained Man

Look over the fields of work which are open to the young man today. You will find that Aviation is the ONE FIELD that is not overcrowded—the ONE FIELD in which there is plenty of room at the top. Think of it! Only 21 years ago Orville and Wilbur Wright made the world's first airplane flight. Now airplanes fly around the world. Yes, Aviation offers the same wonderful opportunities today that the automobile and motion picture industries did 15 and 20 years ago. Men who got in on the ground floor of those industries made fortunes before others woke up. AVIATION IS NEW! It clamors for nifty young men—and the trained man has the world before him in Aviation.

Easy to Become an Aviation Expert—\$50 to \$100 a Week

You can qualify now quickly for one of these exciting, highly paid jobs through a new, sure, easy method of training. The study of Aviation is almost as interesting as the work itself. Every lesson is fascinating and packed full of interest. That's why Aviation is so easy to learn—you don't have to force yourself to study—once you start, you can't get enough of it. Only one hour of spare time a day will give you the basic training in an amazingly short time.

One student, S. F. McNaughton, Chicago, says:

"Your lessons are like a romance, and what is more, after one reading, the student gets a thorough understanding. One never tires of reading them." James Powers, Pa., another student, says: "I am indeed surprised that such a valuable course can be had from such practical men for so little cost."

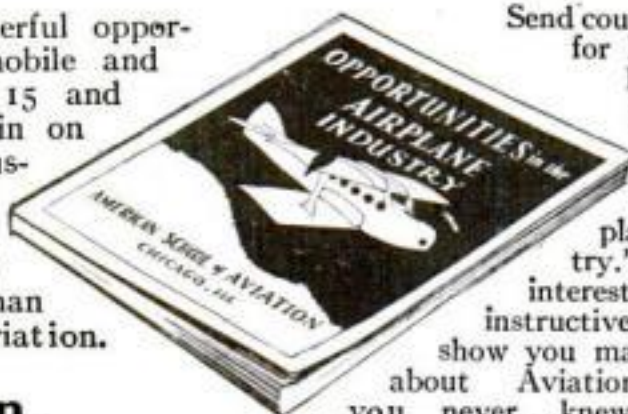
Personal Instruction by Experienced Men

PREPARE For One of These POSITIONS

Aeronautical Instructor \$60 to \$150 per week
Aeronautical Engineer \$100 to \$300 per week
Aeronautical Contractor Enormous profits
Aeroplane Repairman \$60 to \$75 per week
Aeroplane Mechanician \$40 to \$65 per week
Aeroplane Inspector \$50 to \$70 per week
Aeroplane Salesman \$5000 per year and up
Aeroplane Assembler \$40 to \$65 per week
Aeroplane Builder \$75 to \$200 per week

Men who have had actual experience in Aviation give you personal attention and guide you carefully through your training. They select the lessons, lectures, blueprints and bulletins. They tell you the things that are essential to your success. Every lesson is easy to read and quickly understood.

Big Book on Aviation FREE



Send coupon below for New Free Book, just out, "Opportunities in the Airplane Industry." It is interesting and instructive and will show you many things about Aviation which you never knew before.

Only a limited number offered—get yours before the edition is exhausted.

AMERICAN SCHOOL OF AVIATION
Dept. 1367, 3601 Michigan Ave., Chicago, Ill.

AMERICAN SCHOOL OF AVIATION,
3601 Michigan Ave., Dept. 1367,
Chicago, Ill.
Without any obligation, send me your Free Book, "Opportunities in the Airplane Industry," also information about your Course in Practical Aeronautics.

Name.....
Street.....
City..... State.....

It Is Easy to Succeed

(Continued from page 4)

write to the advertisers who are ready to help you reach the top of the profession or trade you have chosen.

The man who has a driving ambition to get ahead can secure a specialized training without its interfering with his present employment and at a cost he can afford.

Correspondence schools, extension courses, and educational books show the way to the man handicapped by a lack of education.

POPULAR SCIENCE MONTHLY is the great meeting-place for men-who-want-to-succeed and the schools and publishers who can help these men achieve their ambitions.

Every month you will find in POPULAR SCIENCE MONTHLY hundreds of advertisers holding open to you the door to success. Starting with this issue these money-making opportunities will be grouped together for your convenience in finding the path you want to follow. Read every advertiser's offering, see what the opportunity is in each field, decide which calling you have the greatest natural interest in, and then go to it with all the determination you possess.

Only education, plus determination to succeed, can make you a success in life.

As a further incentive to succeed we are offering \$100 in Cash Prizes for the best letters telling us the advertisements our readers like best—and why. See the details of this offer on page 142.

New Process of Welding

CHROMIUM and other metals that cannot be welded by ordinary methods are conquered by a new discovery made by Dr. Robert W. Wood, of the Johns Hopkins University, working for the General Electric Company. The stubborn metals are welded by breaking up hydrogen into dissociated atoms, which is done with electricity.

Special Rooms for Tall Men

WHEN tall men stop at hotels they often find accommodations cramped. Ever obliging, one big New York City hotel is altering rooms on its top floor, especially to suit six- and seven-footers.

Door frames will be built so that the lengthy guest need not bump his head. Extra long bathtubs and beds and other furniture built to special measurements, will add to the visitors' comfort.

Chew Well to See Well

CHEW well if you would see well, urges Sir Arthur Keith, a great British anatomist. Decreased exercise of the jaws, and not eye strain, is causing short sight, he claims. Diminished use of the jaws in masticating the soft foods of modern diet, he asserts, is changing the shape of the face, lengthening the eye sockets, thus elongating the eyeballs and weakening vision.

"Up to the Minute"

I find POPULAR SCIENCE MONTHLY as interesting as my radio set, and they both keep me informed right up to the minute.—E. H., Bogota, N. J.

Will You Take These Men's Word For It?



**\$700 in
24 Days**

"Thanks to you, I made \$700 in 24 days in Radio," says F. G. McNabb, 848 Spring St., Atlanta, Ga. "I recommend your training everywhere."

These Four, and Thousands of other Men earning \$70 to \$200 a Week, Recommend This Training to You!



**\$1000
a
Month**

John Jirnee, 1123 Fourth Avenue, Astoria, L.I., now earning \$12,000 a year, recommends Cooke Training. He says, "It alone is responsible for my success."

START NOW Be an

ELECTRICAL EXPERT

LEARN to EARN

\$3,500 to \$10,000 a Year!

Don't you keep on working for only \$25 or \$35 a week. Get into Electricity. Thousands of Cooke Trained Men who knew nothing about it a short time ago are now earning \$70 to \$200 a week as Electrical Experts—and they don't work half as hard as you do. Why stick to your small pay job? Why stick to a line of work that offers no chance—no promotion—no big pay? Get into the world's greatest business. Electricity needs you. I'll show you how to do it. Get ready for the big pay job now.

Electrical Experts Are In Big Demand

Even ordinary electricians—the "screw driver" kind—are making big money, but trained men—Electrical Experts who get the top salaries—are needed more now than ever before. Thousands of Cooke Trained Men easily earn \$3,500 to \$10,000 a year. That's the kind of a job you want—where you can plan and boss and supervise the work of others or go into business for yourself. Get started towards one of these big-pay jobs now. Learn to earn \$70 to \$200 a week—you can do it with Cooke Training—recommended by more than ten thousand successful graduates. Just mail the coupon below.

Age or Lack of Experience Bars No One

You don't need experience. You don't have to be a College man. You don't have to be even a high school graduate. As Chief Engineer of this big two million dollar institution which does a general Consulting Engineering Business besides operating one of world's greatest Training Schools, I know just what training you need to make a big success in electricity.

Let me give you that training with my simplified, complete home course—the world famous "Cooke Training"—built on my own 20 years of engineering experience with the help of nearly 50 other engineers. Learn to earn \$70 to \$200 a week—only spare time needed.

My Training Pays For Itself

You can start earning extra money a few weeks after you start my training. I give you special instruction for doing simple electrical jobs in your spare time—show you how to get these jobs and tell you what to charge. Many of my students make as high as \$25 a week extra this way while studying. My course more than pays its own way.

Your Satisfaction Guaranteed

I am so sure I can make you a big success in Electricity, just like I have done for the men whose pictures you see here and thousands of others who now boost my training, that I will guarantee your satisfaction with a signed, money-back guarantee bond. If my training doesn't satisfy you after you have finished, you get back every penny you pay me. A two million dollar institution stands back of this guarantee.

Get Started Now—Mail Coupon

Get my big free book—"The Vital Facts about Electricity." Read about the success of hundreds of other men—men who recommend this training and whose names and addresses are given in my book. Get the real dope about your opportunities in Electricity. See how easy it is to get started on the road to jobs that pay \$70 to \$200 a week. Don't deny yourself this chance to make big money. Get the facts now—Mail Coupon at once for facts and my guarantee.

**L. L. COOKE, Chief Engineer
CHICAGO ENGINEERING WORKS, Inc.**

**Dept. 37
2150 Lawrence Ave.
Chicago, Illinois**

**MAIL
COUPON FOR
FREE
BOOK OF
FACTS**

L. L. COOKE, Chief Engineer, who has trained thousands of men for Big-Pay Jobs in Electricity.

ENGINEERS' ASSOCIATION ENDORSES COOKE TRAINING

The American Association of Engineers, with 15,000 College and Practical Engineer Members, has approved Cooke training and the C.E.W. 100%. Their printed and publicly distributed report of their investigation is the only endorsement of a school they have ever issued. Full details of this endorsement sent with my free book.

**L. L. COOKE, Chief Engineer,
CHICAGO ENGINEERING WORKS,
Dept. 37
2150 Lawrence Ave., Chicago, Illinois**

Send me at once, without obligation, your big illustrated book and complete details of your Home Study Course in Electricity, including your outfit and employment service offer.

Name.....

Address.....

Occupation.....



\$9,000 a Year Auto Electricity pays W. E. Pence, Albany, Ore., over \$9,000 a year. 58 men enrolled for this training on his recommendation.



\$125 a Week "Depend on me as a booster," says A. Schreck, Phoenix, Arizona. "I make over \$500 a month. Your advertisement started me to success."

5 WONDERFUL WORKING OUTFITS—Given without extra charge!

- 1 LABORATORY AND EXPERIMENTAL OUTFIT. Complete material for interesting experiments.
- 2 BELL AND ALARM OUTFIT. Electrical apparatus, material and tools—a complete installation kit.
- 3 ELECTRIC LIGHTING OUTFIT. Switches, Wire, Lights, etc.—everything needed to make up all complicated electric lighting circuits.
- 4 ELECTRIC POWER OUTFIT. The Famous "Cooke" Motor and other apparatus. Not a toy—but a real, honest-to-goodness workable machine.
- 5 TRANSFORMER OUTFIT. Complete parts for building and winding this widely used equipment.

The 'Cooke' Trained Man, is the 'Big Pay' Man!

NOW FREE!

The Book That Shows the Way
TO A **JOB AND BIG PAY** A **RAISE**

Send for
it
Today

BE AN AUTO EXPERT

B.W. Cooke
Student Jos.
Woronecki Made
\$300 in a Week!

If you want Big Pay, a QUICK raise in Pay or a Business of your own—if you're making a cent less than \$5 a week—**CLIP THAT COUPON RIGHT NOW!** I'll send you my big Book "AUTO FACTS" without a penny's charge.

This Book Has Shown Hundreds of Men the Way to Success!

The book that I am offering to send you **ABSOLUTELY FREE** is the same book that started hundreds of men on the way to *Amazing Salary Increases* and big successes as Auto Experts.

Why Just Look Here! Joseph Woronecki, Hartford, Conn., was only making \$21 a week when he wrote for my book. Recently he wrote that he made \$300 IN A SINGLE WEEK!

Mr. Woronecki is just **ONE** of **HUNDREDS** who are making *big money* as Auto Experts. Send the coupon and I'll give you **FACTS—proof a fact!** I'll show you that **YOU** can have *real success* and **BIG PAY** as a B. W. Cooke "JOB-WAY" Trained Man—if you are between the ages of 15 and 60 and can read and write plain English.

Get into the World's Biggest Business—It Needs You!

Get all the facts about this wonderful Auto Business—the **Biggest Business** in all the World—it **needs you!** East, West, North, South—everywhere—**BIG JOBS** paying all the way up to \$150 a week, are waiting for trained Auto Experts. Thousands of Money-Making Opportunities are waiting for **YOU!** Think of it—**FIVE Thousand Million Dollars** are poured into the pockets of Auto Experts every year in this Gigantic World Reater Industry! Learn how you can get your share of the **BIG PAY** and get it **QUICK!**

LEARN AT HOME THE COOKE "JOB-WAY"

Keep your present job. Get started on the way to Big Pay as an Auto Expert through Cooke "Job-Way"—**quickly, easily, RIGHT IN YOUR OWN HOME!** Being a practical Directing Engineer, Owner and Head of this Institution, I know what practical, money-making training you need to be a **BIG PAY MAN**—and that training I give you! My free Book shows you how successful I've been and how successful I am.

HERE'S PROOF! See What I Can Do for You!

\$700 in Spare Time Money. That's what Cleo Crowl, 215 Washington St., Medford, Oregon, earned in spare time before graduation. See how you can make your spare time bring you **CASH**.
100% Raise in 10 Months. Harry Atkins, 38 Day St., Fitchburg, Mass., made enough in his spare time while taking my training to pay up all of his debts—and on top of that **Doubled His Salary** in a few short months.

The Only "JOB-WAY" Training on Earth!

Find out about this remarkable "QUICK RESULTS" Training. B. W. Cooke "Job-Way" trains you to be your own boss—to hold down the **HIGH SALARIED JOBS**. Includes all Electrical work—Ignition, Starting, Lighting—all Mechanical end, Welding, Brazing, Vulcanizing—also Business Course, Salesmanship, Advertising, Buying, How to Keep Simple Books

—also *Automotive Magazine*, also 3 *Outfits*. Nowhere else can you get the original, genuine copyrighted Cooke "Job-Way" training. I train you with Tools which I give you, and illustrated **JOBS**—not books. Learn what Cooke "Job-Way" has done for others. See what it can do for you. **MAIL COUPON TO ME RIGHT NOW!**

You Can Make Big Money Too!

You've got just as much ability as Walter Mayville, Harold Lester, M. J. Morrison, Herbert Trask, Allen Pomeroy and dozens of others, who only a few months after enrolling, were their own bosses, in their own businesses, making **REAL money!** I'll prove to you that you can reach success quickly and easily too. I'll show you how I back you up with the entire resources of this great Institution—how I give you Employment Service without extra cost for your entire lifetime. Also Lifetime Consultation Service. Get all the facts. Send for my Big Free Auto Book right away!

Address me **B. W. Cooke** Directing Personally **Engineer**

CHICAGO MOTOR TRAINING CORPORATION
1916 Sunnyside Ave., Dept. 725, Chicago, Ill.

3 Big Outfits GIVEN
No extra cost

Tools, Test Bench, Radio Set, all equipment included. Coupon brings full details of wonderful offer.

What Is Evolution?

(Continued from page 26)

form was hardly larger than a walnut, hard and bitter. Then there is Luther Burbank with his classic experiment with potato seeds from which there evolved the Burbank potato.

Today there exist thousands of forms of animals and plants that reproduce their kind that did not exist a century ago.

6. Every-day evidences. Scientists call evolution at once the most obvious and the most vital fact of life as we know it. We see it, they say, in operation all about us. We see the seed spring into a plant that blossoms and withers. We see the egg change into a chicken, and the tadpole into a frog. Rivers change their courses. The tide rises and falls. Day turns into night. All these changes have been observed by man for centuries.

AND science says, too, that we can see evidence of evolution in our gardens, among our children, in the marvelous machines developed for our use from the crudest of implements—even in the ideas that we conceive and unfold. Your life from beginning to end, says science, is change and progress, steady, upward; from helpless ignorance to intelligence and power.

This is what science means by evolution as the compelling force of creation.

There are any number of books in which you will find the theory of evolution further described and amplified. For these I suggest that you consult your library.

D. A. TURNQUIST,
Information Department.

An Unnamed New Gas

DURING the recent eclipse an unfamiliar gas was observed about the sun by scientists who were making careful observations. But, according to Prof. Frederick Slocum, head of the Van Vleck Observatory at Wesleyan University, who recently made the announcement, scientists are not yet prepared to name the gas or to discuss its properties.

Filter Makes X-Ray Harmless

A FILTER that is said to render X-rays harmless and that is claimed will cure radio-dermatitis, a disease that has killed and maimed scientists using the rays comes from the Paris Academy of Sciences. The filter is of a plastic material that allows only the red and yellow rays to pass.

Tiniest Counter Improved

NEW accuracy in the tiniest of measuring devices—the mechanism by which blood corpuscles are enumerated—recently has been attained by the U. S. Bureau of Standards. In the past, the count of blood corpuscles, an important aid in diagnosis and treatment of diseases, has been somewhat inaccurate.

The new method, devised by C. G. Peters and B. L. Page, applies a new principle based on the phenomena of light-wave interference under the microscope, resulting in greater speed and accuracy in blood counts.

MAIL "JOB-WAY" COUPON

B. W. COOKE, Directing Engineer
Chicago Motor Training Corp., Dept. 725,
1916 Sunnyside Ave., CHICAGO, ILL.
Send me **FREE** Auto Book and proof that I can become an Auto Expert at home in spare time. Also send your wonderful offer of 3 Outfits included. It is understood that this obligates me in no way and no salesman is to call on me.

Name
Address
State
Town

If it isn't "B. W. Cooke-Way"—it isn't "Job-Way"

Give Me 5 Days and I'll Give You a Magnetic Personality Let Me Prove It — FREE!

I CAN so magnetize your personality that people will be drawn to you at once, irresistibly.

I can make you a magnet of human attraction so that you are popular everywhere, in any society.

I can show you how to use the amazing principle of magnetic control to win quick and conspicuous success in your business or profession.

I can place in your hands the key to supreme power and happiness—give you a great new confidence in yourself—overcome almost at once any timidity or self-consciousness you may have.

I can give you a glorious new magnetic personality so that you can influence the minds of others, attract people to you instantly, be popular and well-liked wherever you go!

Let me prove it. Give me 5 days, and if in that time you do not experience a new surge of personal power, if you do not find yourself making friends wherever you may be, if you do not discover yourself on the road to happiness, wealth, success—guided by my principles of personal magnetism—the test will cost you nothing whatever. You are the judge.

What is Personal Magnetism?

You have it—everyone has it—but only the exceptional man or woman knows how to use it.

Personal magnetism is not a fad or fancy, not some sudden discovery or some new psychological theory. It is you, your manner, your self—made magnetic. It is a force as irresistible as the force of the actual magnet, drawing a bit of steel to itself. No leader of men has long survived without it. No great orator

or musician or actor can hold audiences spellbound without it. No salesman, no business man, can win an outstanding success without it. Personal magnetism! It is your greatest capital—greater by far than wealth, than good looks. It is you, made magnetic! It is you, with a personality so fascinating and irresistible that people are drawn to you as steel is drawn to a magnet!



Think what personal magnetism will mean to you in business, in your contact with men and women. You will win! You will get what you want!

My Method Releases Your Personal Magnetism

No long course of study. No tedious mental exercises. Not the slightest inconvenience or self-denial. Just a simple, clear, age-old principle that taps the vast thought and power resources within you, releases the full sweep of your magnetic potentialities—and makes you almost a new person from what you were before. A principle that never fails to work, because it conspires with Nature to make you the dynamic, forceful, fascinating person you were intended to be.

Not Hypnotism—But Magnetism!

Please do not mistake my method for hypnotism. Its laws and its results are exactly opposite. Hypnotism deadens—magnetism imparts a joyous exhilaration to body and mind. Hypnotism paralyzes the will—magnetism animates, inspires, sharpens and strengthens the mental faculties.



The fundamental principles of Personal Magnetism have been put into a series of four handy-sized volumes under the title of "The Cultivation of Personal Magnetism." These books give you the key to a magnetic personality—or they cost you nothing. That is my free proof offer to you.

The study and scope of Personal Magnetism is as broad as life itself. "Fires of Magnetism," "Sex Influences," "The Magnetic Voice," "Physical Magnetism," "The Magnetic Eye," "The Road to Power" and "The Winning Personality" are only a few of the subjects covered in this amazing series of books.

Remember My 5-Day Free Proof Offer! Send Off the Coupon TODAY

You must see them for yourself—examine them—let them influence indelibly your own personality. If you aren't stirred and inspired in the 5-day free period, return them and they cost you nothing. Otherwise keep them as your own and remit only \$3 in full payment for the four books. You are the sole judge. You do not pay unless you are delighted. And then you pay only \$3 for the four remarkable books!

You simply can't delay! Clip and mail this coupon NOW. Ralston University Press, Dept. 14-S, Meriden, Conn.

RALSTON UNIVERSITY PRESS,
Dept. 14-S, Meriden, Conn.

All right—I'll be the judge. You may send me the four volumes "Cultivation of Personal Magnetism" for 5 days FREE EXAMINATION in my home. Within the 5 days I will either remit the special low price of only \$3.00 for the four books complete, or return them without cost or obligation.

Name.....

Address.....

City.....State.....



You will be astounded to see how popular you quickly become—how people are drawn to you. Never again will you feel lonesome at a party—forgotten in a crowd! You will be—MAGNETIC!



Thousands Can Draw CARTOONS

Who Have Never Even Tried

Cartoonists earn \$60 to \$300 a week. Why work at drudgery when through a remarkable new method you can easily learn at home in spare time to draw cartoons that **SELL**?

MANY are earning pitifully small salaries who could make wonderful salaries in cartooning. Briggs, Fox, Fisher, Goldberg and other leading cartoonists earn more than the President. Yet a few years ago many of our most successful cartoonists never dreamed they could draw a good cartoon!

The World's Easiest, Pleasantest and Best Paying Profession

Just watch a cartoonist work. A few little lines—a couple of simple curves—a splash of black here and there—and then you see a splendid cartoon before you. With a few strokes of his pen, he has taken some little incident of his day's experience—some humorous or sad scene he has witnessed—and produced a wonderful cartoon.

New Easy Way to Learn Cartooning

This fascinating ability to draw cartoons can now easily be yours—Through a wonderful new home study method, you receive a complete training in Cartooning, and personal corrections on all of your work from one of America's foremost cartoonists!

With his help, you can in an amazingly short time, learn to draw the comic strips, humorous, political and animated cartoons which are in such big demand.

Learn More About Cartooning Send for FREE BOOK

Never have cartoons been so popular. Millions of were spent last year on cartoons of all kinds—and every week newspapers increase the amount of cartoons used. Learn about the amazing opportunities in Cartooning and all about this remarkable home study method. Mail coupon for **Free Booklet** today. Washington School of Cartooning, Room 2410-C, 1113-15th St., N. W., Washington, D. C.

WASHINGTON SCHOOL OF CARTOONING,
Room 2410-C, 1113-15th St., N. W., Washington, D. C.

Please send me without obligation your illustrated
FREE BOOKLET on Cartooning and details of Free
Offer.

Name _____
(Write name plainly—State Mr., Mrs. or Miss)

Address _____

City _____ State _____

If under 16 years, please state age _____

"STAMMERING Its Cause and Cure"

You can be quickly cured if you stammer. Send 10 cents, coin or stamps, for 288 page cloth bound book on Stammering and Stuttering. It tells how I cured myself after Stammering and Stuttering for 30 years. **BENJAMIN H. ROGUE**
7522 Rogue Building, 1147 N. H. St., Indianapolis

**BURN YOUR NAME ON TOOLS
WITH THE
ARKOGRAP**

Protect Your
Tools From Theft. Write with elec-
tricity any name or design on the hard-
est and finest tools and instruments, or
any metal, like writing on paper with
pen or pencil. Complete Outfit
\$3.50 Prepaid Anywhere. Interest-
ing illustrated circular free. Write to-
day. Agents wanted.
ARKOGRAP PEN CO.
1171-A East Stark St., Portland, Oregon

Can Man Reproduce the Sun?

(Continued from page 29)

reproduce the effect of the sun itself.

Dominating the entire plant is the direct-current generator—perhaps the 10,000,000-volt apparatus now being planned, possibly a greater. High above this stand two giant electrodes, placed 50 or more feet apart. Between them is a complicated network of wires and pipes connecting with tanks and vacuum chambers in which is stored until needed the power generated by the plant.

The operator is seated at a switch-board in an inclosure of heavily tinted glass. He glances at a typewritten order, closes the door of his glass house and twists two or three dials. "We are going to disintegrate helium atoms this time," he remarks. "A pound of helium releases a radiation of heat equivalent to that given by burning 10,000 tons of coal—enough to heat your house for about 1000 years."

He closes a switch. Between the giant electrodes there leaps a blue-white bolt that builds up into a mighty orb of incandescent fire as the electric current blasts into the atomic structure of the helium.

Even through the tinted glass the glare is almost blinding. The operator does not look up. His eyes are fixed on the dial of a split-second clock on the control board. Suddenly he pulls open a switch. The glare and crackling cease.

"In three seconds," he says, "we've made enough power to drive the old *Mauretania* around the world a dozen times!"

WHAT would happen to the power generated by this man-made sun? Some of it, in the form of electricity, could be transmitted over high-tension lines to run railroads and operate factories in distant cities. A portion of it might be used to warm houses and office buildings perhaps thousands of miles away. In the form of a liquid, giant liners could use it as fuel for their trips across the sea.

Most of the recognized savants of the scientific world agree that the breaking down of the atom will result in the generation of an incalculable flood of power. Chained by the mysterious attraction that holds each electron in the orbit of the nucleus of its own particular atom, there is enough power in a cup of water to pull a 40-car freight train from New York to San Francisco and back a dozen times.

Atomic disintegration offers wonderful possibilities of cheap power, of power concentrated into such a small space that the contents of a medicine vial would drive the airship *Los Angeles* over the North Pole and back to her hangar, of power of such marvelous potency that a single-tank car would provide fuel for our navy for a long war.

If Professor Perrin, aided by the new 10,000,000-volt generator, is able to disintegrate even a few of the elusive atoms, he believes that he will at least have blazed a trail leading toward a permanent source of heat, light, and power that will revolutionize almost every phase of modern civilization.

Why are women afraid of lightning?

DO YOU KNOW all the strange facts about lightning—what causes rains, tornadoes, cyclones, and all the other terrifying tricks of the atmosphere? Get your copy to-day of a great new book—

OUR WEATHER

What makes it and how to watch it

This useful book, written by the noted authority on Meteorology, Charles Fitzhugh Talman, explains to you the whole wonderful Science of Atmosphere—how to know when rains and storms are coming—how to make your plans without fear of the weather. At bookstores—or send us \$3.

REYNOLDS PUBLISHING CO. INC.,
250 Park Avenue, New York City.

I enclose \$3.00. Send me "Our Weather," by return mail.

Name.....

Address.....

SELL FOOT COMFORT

**\$20
a Day**

Many of our men make it; so may you—selling "World's Greatest Foot-Comfort Shoes" direct to men and boys everywhere. Sell on sight.

Low priced. Give real comfort, long wear. Shoes or oxfords. Great for semi sport, scuff or general wear. Just take orders; we mail shoes direct. Big cash profit on every sale and repeat. Thousands worn in every state. Territory protected. Live wires soon advanced. Best season NOW. Write Dept. 233. **EASY-WEAR SHOE CO., INDIANAPOLIS, IND.**

Learn Photography at HOME

Make \$75 a Week on the Side

Establish yourself as a Photographic Expert quickly—during your spare time—under a leading photographer. I'll show you how to start your own business—no experience—large salary. Send for my unequal offer—it's only temporary. Act at once. A postal will do. **International Studios, Inc., Dept. 1367**
3601 Michigan Avenue, Chicago, U. S. A.

ARITHMETIC OF ELECTRICITY

A practical treatise on electrical calculations of all kinds reduced to a series of rules, all of the simplest forms, and involving only ordinary arithmetic. 200 pp. Price, \$1.50.

POPULAR SCIENCE MONTHLY
250 Fourth Avenue :: NEW YORK

See—

the big Prize Offer
on page 4 of this
issue.

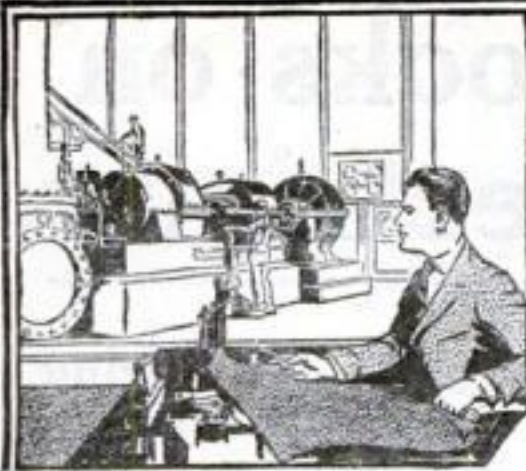
STUDY at HOME

Directed by

The University of Chicago

Courses in English, History, Chemistry, Business, Mathematics, Education, Psychology, and 35 other subjects command credit toward a Bachelor degree. Begin any time. Address 25 Ellis Hall, University of Chicago, Chicago, Ill.

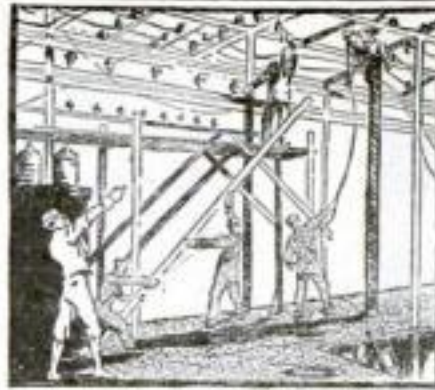
SAVE 1/3 TO 1/2!
Everything in Radio
WRITE FOR CATALOG—FREE
RANDOLPH RADIO CORP.
159 N. UNION AV. Dept. 3 CHICAGO, ILL.



Be Superintendent of an Electrical POWER PLANT



Own Your Own Electrical REPAIR SHOP



Boss Electrical Construction Jobs



Be an Electrical CONTRACTOR

Train At Home
for a fine
ELECTRICAL
JOB and
a big **RAISE**
IN
PAY!

Go into ELECTRICITY!

--the Business of a Million Opportunities

Be an Electrical Expert. Go into the one great industry where it's easy to get to the top, to make money, to make a real success. You don't need money in the bank or "pull" to get ahead in Electricity—all you need is training, honest, complete training, such as I guarantee.

BIG JOBS OPEN Everywhere!

Look at the building business. Thousands of Electrical Contractors are getting rich. Their men are making \$10 to \$20 a day. Look at the fortunes being made in Radio. Look at the great factories building every kind of Electrical machinery. Why, the work of the world is being done by Electricity and the call for trained men exceeds the supply!

If you're now earning less than \$40 a week

—if you want to be an ELECTRICAL EXPERT—if you want to step quickly into the class of men earning from \$60 to \$250 a week—write me at once! This million dollar school offers ambitious fellows their big opportunity to learn every branch of Electricity at home in spare time by a new, practical JOB-METHOD.

Learn Electricity Quick by Dunlap "Job-Method"

My training so simple a school-boy can grasp it instantly. Common schooling all you need. No previous experience required. But my students make rapid progress because I train them on actual Electrical jobs with standard-size tools and materials which I supply without extra cost. The first half of my training is APPLIED ELECTRICITY—a complete course in itself. In the second half I give you Electrical Engineering subjects. I give you. Electrical Drafting, Radio, Automotive Electricity, and many other valuable subjects, all for one small price, and on easy terms.

Train for These Jobs

Power Plant Superintendent, \$5,000 to \$15,000 a year; Construction Foreman, \$3,500 to \$10,000 a year; Chief Electrician, \$3,000 to \$12,000 a year; Electrical Draftsman, \$3,000 to \$10,000 a year; Automotive Electrical Expert, \$3,500 to \$12,000 a year.

EARN MONEY While Learning

Dunlap-training combines money-making, practical experience, and instruction IN A NEW WAY. I call this "JOB-METHOD" and it gets results—more quickly and easily than old-fashioned ways of teaching. Early in your training I give you special instruction in house-wiring, Radio-building, Electrical Repair Work, etc. I show you how to get spare-time work—work you'll be well paid for.

THESE 4 BIG ELECTRICAL OUTFITS GIVEN

to you without one penny of extra charge. Not a "premium"—not something "FREE" to induce you to enroll. But costly, standard, full-size tools, materials and equipment. The man-size motor of the same type as the big-fellows in a power plant. Not a toy, but a regular power-motor. Runs on Alternating or Direct Current, or 32-volt farm electric system. Comes to you knock-down. It's part of your job to wind the armature and assemble it. That's the way you learn every branch of Electricity by the Dunlap Job-Method.

Get My PAY-DOUBLING OFFER!

Before you put your time and money into home-training, you want to know if it will lead to a better job and bigger pay. I will answer that in plain English. Get my catalog, my wonderful new guarantee, my sensational offers—quick! Get the facts about your opportunities in Electricity when you are Dunlap-trained and when you have the backing of the American School. Before you enroll for any home-training, get the facts about my training, so you can compare it intelligently with others. Write me today!

JOB SERVICE

At No Extra Cost to STUDENTS and GRADUATES

jobs, not only to graduates, but to STUDENTS also. This JOB-SERVICE keeps in touch with great Electrical employers all over America. The day you enroll, this Job-Service Department registers you, finds out what kind of job you want, where you want to work, etc.

And when you apply for the job you want, we back you with our recommendation and help you make good in it after you get it.



THE AMERICAN SCHOOL is chartered under the laws of Massachusetts, as an educational institution NOT FOR PROFIT. Established 29 years. Over 200 Executives, Engineers, and Educators have prepared the texts used in these wonderful home-study courses. The success of our graduates has made us one of the largest VOCATIONAL TRAINING Institutions in the world. You will be astonished at the many ways we help our students and graduates progress to success.

I WANT TO BE AN ELECTRICAL EXPERT!

Chief Engineer Dunlap
AMERICAN SCHOOL, Dept. E-775
Drexel Ave. & 58th St., Chicago

☐ I want to be an Electrical Expert. Please rush guarantee, job-service facts, complete information, money-saving offers.

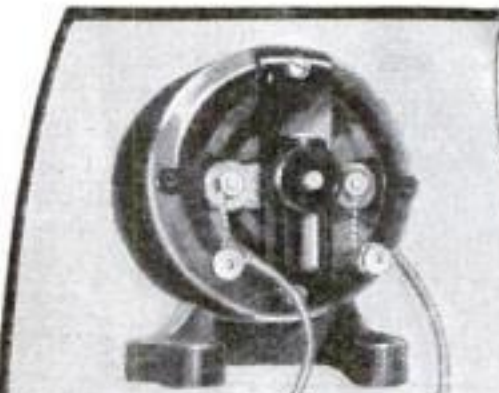
Name.....

Street No.....

City.....State.....

MAIL COUPON TO-DAY

Chief Engineer Dunlap, Electrical Division
AMERICAN SCHOOL
Dept. E-775
Drexel Ave. & 58th St. CHICAGO



\$10 Motor-4 Big Outfits Given to every Student Not a Penny Extra Cost



Chief Engineer DUNLAP

23 Training Built by NOTED ENGINEERS

This is not a one-man, one-idea school. 22 famous Engineers and Executives of the following corporations and universities helped me make Dunlap-training the most complete and up-to-date:

1. General Electric Co.
2. Commonwealth Edison Company
3. Crocker-Wheeler Co.
4. Cutler-Hammer Mfg. Company
5. American Telephone & Telegraph Co.
6. Westinghouse Electric & Mfg. Co.
7. Western Electric Co.
8. Underwriters Laboratories, Inc.
9. Columbia University
10. Dartmouth College
11. Massachusetts Institute of Technology
12. Lehigh University
13. University of Vermont

AND MANY OTHERS

Ask any well posted Electrical Engineer about the quality and standards of AMERICAN SCHOOL home-training in Electricity.



You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.

Houdini—The Man

(Continued from page 154)

lead the rigorous life of a pugilist in training. As the contortionist said, 'I must starve myself to do my work, and I'll starve if I don't work.'

"You're convinced, then, that all psychic phenomena are produced by trickery?"

"All that I have seen," said Houdini; "and I've searched far and wide for genuine manifestations. For years I've offered as much as \$10,000 to any medium, psychic, or seer who could produce a physical manifestation of his boasted power that I could not reproduce by natural means. I've had some challenges—but I still have my \$10,000. I wish," he added with a smile, "that some medium would make me a counter offer on the same terms—to reproduce by his methods a trick that I would perform by mine."

"What do you consider your best trick?" I asked him.

"I SHOULDN'T care to select any single trick as my best one," he replied thoughtfully. "My four best, though, probably are the disappearing elephant, the Chinese torture chamber (this is the trick, described above, in which Houdini is locked in the metal cylinder filled with water), the needle trick, and permitting myself to be shackled, nailed into a packing-case weighted with 500 pounds of pig iron, and thrown overboard."

"You say you perform all these feats by trickery," I said. "Does that mean that when you're thrown overboard, for example, you're in no physical danger?"

"I'll say it doesn't!" responded Houdini fervently. "Of course, I perform no tricks without rehearsing them; yet there is always the danger of some little thing going amiss and not only spoiling the trick, but spoiling me as well—permanently. The former has happened several times, and as a result I've had some very narrow escapes."

"I permitted myself to be shackled hand and foot and buried alive in California some years ago. I had previously escaped successfully from graves from one to five feet deep, but when I was placed in a six-foot grave, I lost my self-possession temporarily. As a result, instead of proceeding calmly and carefully about the work of freeing myself, I began to struggle, frantically and aimlessly, and I attempted to call for help. My efforts sapped my strength; my attempts to shout caused me nearly to be suffocated. Luckily I mastered myself in time, and managed to squirm to the surface more dead than alive. And if it rests with me, that is the last time that particular trick ever will be performed."

"ANOTHER time, I nearly brought my career as an entertainer to a sudden end by doing the Chinese torture chamber trick in a cask of ale. The fumes of the ale intoxicated me, and I have no recollection to this day of completing the trick."

"In Buffalo, N. Y., several years ago, a gang of longshoremen from the lake front accepted my challenge to any one to tie me up so that I could not escape. They came

(Continued on page 156)

For 22 years from this
Recognized College of Engineering
A Home-Study Course in
DRAFTING

Everything today is built from drawings made by Draftsmen. Industry calls for 50,000 new men yearly. Draftsmen work hand in hand with the architect, the engineer, the designer, the builder. And thus many men rise from such positions to be heads of great contractors' organizations, directors of railroads, chief engineers—responsible positions commanding very attractive salaries.

FREE TRIAL LESSON

Prove your fitness and liking for one of industry's highest paid professions. We want you to know what Drafting is like . . . how readily you can progress . . . how we train and teach you by mail. So, before you enroll . . . FREE . . . without cost or obligation . . . we send you a trial lesson to study in your own home.



Mr. John Hocke

DRAFTING
HALL OF FAME

Mr. John Hocke who is now successfully practicing architecture in Chicago, is a graduate of Chicago Technical College, '13.

He says: "The instruction I received from your College has provided a thorough foundation for solving any problems as they present themselves in my office."

NOTICE—A well established Placement Bureau assists both graduates and undergraduates to find positions.

Within Ten Months
Increase Your Income

No special training or talent is required. In 10 months' time or less . . . we can train you . . . at home, in your spare hours . . . to be an expert Draftsman.

And remember this: In Drafting, a big income is open to every properly trained man. Thousands today are earning \$35 to \$100 per week. The reason is simple: Good Draftsmen are in constant demand.

Book of Facts FREE

We will send you a 40-page Book. It tells you all about Drafting . . . and our courses. What prominent men say . . . where Draftsmen are employed . . . their salaries . . . their opportunities . . . what our students have done and are doing . . . how many have increased their salaries even before finishing their courses . . . how many hold high-salaried executive positions today. Tells how 34 instructors give you from this recognized 22-year-old college a practical, short, home-study course.

The Coupon Below
Means Money to You

Find out what Drafting may mean to you . . . mail that coupon. Here is a field in which you can work and win.

We make the test easy, for, with no obligation, we send you a trial lesson FREE. Note the fairness of this offer, the absence of exaggerated promises.

\$25 Outfit Included

When you enroll, you will need drafting instruments; so included in the cost of the course, is a \$25 "lifetime" set. If you have instruments, credit will be allowed. Note that we do not claim to give you these instruments "free". Tuition is low, payments easy.

In Chicago—Earn While You Learn

Those who can come to Chicago will find opportunity to earn living expenses in part-time positions, outside of school hours, while attending day or evening classes at the College.

Chicago Technical College, founded 1904, is known as one of America's oldest and largest schools of specialized engineering. Over 1000 men enroll in resident day and evening courses yearly.

Diplomas in Civil, Mechanical and Electrical Engineering and Architecture granted after two years. Degree of B. S. conferred after three years in the day course. Short courses offered in Drafting, Plan Reading, Estimating, etc. Evening classes for day workers.

If interested in attending Day or Evening Classes at the College in Chicago write for 72-page "Blue Book"—mailed free.

Send Today for FREE Trial Lesson
Fill Out the Attached Coupon NOW

Chicago TECHNICAL College

Drafting—Engineering—Electricity—Architecture . . . all branches

Chicago Technical College,
Dept. 1031, 118 E. 26th St., Chicago, Ill.

Send me, without cost or obligation, your
FREE Trial Lesson and your 40-page Book
of Facts about Drafting.

Name
Address
City and State

FREE 1925 ATLAS With Maps of New Europe

To readers of this magazine who take advantage of this offer now made in connection with

Webster's New International Dictionary

The Merriam Webster
The "Supreme Authority"

A complete reference library in dictionary form, with 3000 pages and type matter equivalent to a 15 volume encyclopedia, all in a single volume, can now be yours on the following remarkably easy terms:

The entire work (with FREE 1925 Atlas)
DELIVERED FOR \$1.00

and easy monthly payments thereafter (in United States and Canada). You will probably prefer the beautiful India Paper Edition which is

REDUCED ABOUT ONE-HALF

in thickness and weight
as compared with the Regular Edition

Over 407,000 Vocabulary Terms and in addition, 12,000 Biographical Names, nearly 32,000 Geographical Subjects. 3000 pages. 6000 illustrations. Constantly improved and kept up to date. Copyright 1924.

"To have this work in the home is like sending the whole family to college." To have it in the office is to supply the answers to countless daily questions.

To Those Who
Send This
Coupon

NOW

G. & C.
MERRIAM CO.

Dept. S., Springfield, Mass.

Please send me free of all obligation or expense a copy of "Dictionary Wrinkles" containing an amusing "Test in Pronunciation" (with key) entitled "The Americanization of Carver"; also, 125 Interesting Questions with references to their answers and striking "Facsimile Color-Plate" of the new bindings. Please include specimen pages of India and Regular paper with terms of your free Atlas offer on Webster's New International Dictionary to POPULAR SCIENCE readers. (10-25)

Name _____
Address _____



3 DRAFTING Lessons actually sent FREE!

to prove you can learn AT HOME
in your spare time!

OUTFIT GIVEN

Full size, high grade instruments, Triangle, T Square, etc.—everything you need—given without extra cost.

I have made Drafting so simple to learn, that any fellow with common schooling can now master it quickly and easily at home in spare time! I will send you 3 interesting lessons free to show you that you can become an Expert Draftsman. At the same time I will tell you all about the wonderful opportunities and big salaries open to Draftsmen. There's a big demand for men who know Drafting from beginning to end, at \$75 to \$125 a week.

Train for Job and Raise

If you're earning less than \$40 a week, go into Drafting. You can learn by my new job-method in a few months. Free Job Service has provided thousands of jobs for both Students and Graduates. Here is your opportunity to get into easy, pleasant work, where you are in line for promotion, and where salaries are BIG.

Send Today! For 3 free lessons, catalog, money-back guarantee, Job Service Information, etc.

Chief Drafting Engineer
AMERICAN SCHOOL, Dept. D775 Chicago



Houdini—The Man

(Continued from page 155)

to the theater armed with the chains, cables, and other apparatus they used in loading cargo on steamers. I thought I had seen about everything in the line of bonds and shackles, but those fellows produced a brand new assortment! I managed to free myself eventually, but I have never forgotten the experience, for a heavy chain that they tightened about my waist with levers crushed one of my kidneys, necessitating my sleeping with a pillow under my back ever since.

"IN BERLIN, Germany, once, a man walked to the stage, and produced from his pocket a small, glittering object. I shuddered when I saw it, for I recognized it as what is called a 'thumbcuff.' This is a particularly devilish sort of handcuff, consisting of a small plate about three inches long by an inch wide, with two circular holes, each just large enough to admit one of the thumbs. This is slipped over the thumbs to the second flange. Then a nut at the side is turned, and circles of small steel pins, each ground to a needlepoint, close about the thumbs. Any movement of the hands causes these needle points to tear the flesh. Obviously if one attempts to pull his thumbs free, the flesh about the joint and the thicker upper flange will be lacerated cruelly.

"Well, having challenged the City of Berlin to produce anything it could in the way of handcuffs, I had to let the man put the thumbcuff on me. Also, I had to escape if I could.

"It was one of the most painful experiences of my career. The spikes penetrated to the bone, and the bleeding flesh hung in strips from my thumbs when at last I dropped the thumbcuff to the stage. Never has one of my tricks been greeted by more tumultuous applause than came to me for this demonstration, which actually was not a trick at all. And when I left the theater, I found myself surrounded by a cheering crowd that raised me to its shoulders, and then unhitched the horses from my cab to draw me in triumph through the streets of the city.

"Once, in the middle of winter, I permitted myself to be shackled hand and foot and dropped through a hole cut in the ice into the Susquehanna River, near Pittsburgh, Pa. In prospect there was nothing terrifying about this feat. I have always been a strong swimmer, accustomed to taking my dip winter and summer. I had made hundreds of water handcuff and rope escapes; so when they dropped me into the hole I was quite as calm as though merely going through my stage routine.

"HOWEVER, I had failed to take into consideration one tremendously important item—the swift current of the river. As a result, I was carried downstream, and when my body rose I was under the ice, which was several inches thick. I had no idea where the hole in the ice was located, I could not, of course, cut another hole through the ice; nor was there any way in which I could signal my plight to those who were waiting for me to emerge.

(Continued on page 157)

\$86⁷⁵ A Week or More

It is a poor week when Earl Hatfield doesn't make more than that in his garage. At 19 years of age, a farmer boy, he came to Detroit the Auto Center, and learned the auto business at this great school. Now he has a fine business near his home, is married, independent, making good money. He is just one of many who have done the same. These successful Michigan State trained men are just plain fellows, no brighter nor better educated than you. Practical training at the factory endorsed school started them to success.

Make Big Money Too

The auto business offers unlimited opportunities. Think of the repair work on 18,000,000 cars. There are not nearly enough trained men to do this work. You can be a skilled mechanic and auto electrician and **Earn Big Money**. Experience isn't necessary. If you are mechanically inclined come to Detroit now, to my school. Become a trained man and go back to your home town. If you run a farm you can increase your profits. Or work as a mechanic, or start a garage of your own.

Learn Autos In Detroit

The Heart of the Industry
Here you have wonderful advantages. Study autos, trucks, engines, auto electricity, tractors. All on best equipment, up-to-date, many new cars; expert instructors; a thorough course that slights nothing. Inspect the great auto plants. These great companies approve this school. Get factory endorsed training at Detroit, the Auto Center.

GOOD POSITIONS OPEN. Here's your chance to be independent. Write today for full information about Detroit training to make the most money.

A. G. Zeller, President

Michigan State Automobile School

390 Auto Building Detroit, Mich.

Drawing Easily Learned

Haven't you often wished that you could draw cartoons, illustrate some idea, sketch some pretty face, etc? You can do all of these things. One of America's most famous Cartoonists and Illustrators has developed a great, simple system for success in all branches of Commercial Art. This system has revolutionized the entire theory of drawing. It means that drawing can be as easy for you as writing—much simpler than learning shorthand, bookkeeping or typewriting. We are now placing this original system for learning Drawing, Art and Cartooning, consisting of 34 lessons with over 500 illustrations, within reach of every one. If you will devote a few hours each week to the Course WE ABSOLUTELY GUARANTEE that you will learn to draw and draw well before you have half finished the Course. If we fail to make this claim good, we will refund every cent paid us. By eliminating a large office force for answering correspondence, expensive catalogs, etc., we are enabled to make a price of \$2.98, the cheapest price ever known for a high-grade, home study course. Many have sent us letters similar to that of Rob't P. Davis of Detroit, who wrote: "I can't see how you ask so little when others with inferior Courses get from \$20 to \$60 for theirs. It is more than I expected." Learn to draw. It is a big asset, no matter what field you are in.

If you order the course at once, we will include a drawing outfit, consisting of artist's pencils, pens, paper, erasers, thumb tacks, etc., enabling you to go to work without any additional cost.

Send No Money

Just order the Course, and on arrival pay postman only a few cents postage. **\$2.98** payment in full for the entire Course and Drawing Outfit. If not entirely satisfied, return within five days and we will REFUND MONEY. Address:

LEDERER SCHOOL OF DRAWING, Dept., 216-C, Chattanooga, Tenn.
Orders from outside the U. S. are payable \$3.24 cash with order

13 WEEKS FOR 15 CENTS

The Pathfinder

SHOWS THE WAY THROUGH THE JUNGLE OF EVENTS

You've heard your neighbor praise the wonderful Pathfinder, the wonderful national weekly home magazine that 3 million people read. You can try this unbiased digest of domestic and world affairs for a trifle. The Pathfinder is in a class by itself—nothing else to equal it: time-tested, wholesome. Chuck full of the choicest reading—the cream of everything. Science, politics, travel, fun, question box, health, radio etc.; real stories, pictures—instruction, entertainment for all. Send 15c (coin or stamps) for this big paper on trial 13 weeks, or \$1 for full year (52 issues). **Pathfinder, Washington, D. C.**

SAVE TIME Secure Better Illustrations
USE AN ALL METAL **PANTOGRAPH**
for roughouts, layouts, enlargements, reductions, checking proportions, etc.
Simple Permanent Economical
Sent postpaid on receipt of \$3.50
Money refunded if not satisfactory.
DRAWING-AIDE CO., 207 Caxton Bldg., Cleveland, O.

Houdini—The Man

(Continued from page 156)

"My only hope of saving myself lay in finding the hole through which I had been dropped. I don't believe I ever did so much fast and serious thinking before or since. As swiftly as I could, I released one of my hands. Then I began moving around in circles, dragging my body along by digging the handcuff on the other wrist into the ice above my head. Gradually I made my circles larger, and at last reaching upward, my hand touched the edge of the hole. Seizing this with the other hand, I anchored myself; then went about my work of releasing myself from the remaining bonds.

"A few seconds later I climbed out of the water to face a white-faced, frightened group of persons who, because of the length of time I had spent in the river, were ready to give me up for lost. And to this day they have never known how nearly right they were!

"I HAVE had many other similar experiences, but those I have described probably will suffice to show that a man who does my kind of work does not always tread a path of roses.

"However," added Houdini, with a meaning glance around his library, "there are compensations."

And as I followed his glance I was convinced that there were. Houdini's handsome home, his marvelously stocked bookshelves, his art treasures, are unmistakable tokens of material success. The autographed photographs of celebrities that line his walls are indicative surely of the esteem in which he is held by the leading men of his generation.

The fact that the Society of American Magicians nine times has elected him its president is proof conclusive that present-day magicians acclaim him "master." He has the love of a devoted wife. He has earned the leisure to indulge himself in the research and study that are his passion. Every man, woman, and child in the civilized world undoubtedly knows his name. With what other gifts could Fortune shower a man?

IN THE first of his extraordinary series of stories for **POPULAR SCIENCE MONTHLY**, Houdini will relate in next month's issue some of his dramatic experiences in exposing fraudulent mediums. He will tell how, by employing ingenious tricks of the magician, he has laid bare the trickery of unscrupulous persons who prey on deluded thousands.

Houdini's own story is full of exciting action and romance. You will not want to miss a single installment of this amazing series. To avoid disappointment, order your copies of the magazine from your newsdealer in advance.

TO DRINK, or not to drink—with meals—has long been an open question. Dr. A. C. Ivy, a University of Chicago physiologist, says "go ahead." Drinking water produces more complete digestion stimulation for the gastric glands, he maintains, and permits more complete absorption of food into the blood stream.

Fast Life Wrecks the Nerves

by PAUL von BOECKMANN

Lecturer and Author of numerous books and treatises on Mental and Physical Energy, Respiration, Psychology and Nerve Culture

WE are living in the age of SPEED, the mile-a-minute life. We crowd two or five years of life into one. We hurry; we worry; and we dissipate, little realizing that there must come an end to our supply of Nerve Force—that we will become nervous wrecks.

Long before a person reaches the final stages of nervous collapse, he passes through months and even years of subnormal nerve power, which seriously handicaps him in life, undermines his constitutional powers and causes all kinds of organic and mental disorders. It would be proper to call these people "near-neurasthenics."

There are countless "near-neurasthenics" about us everywhere—in the streets, in the cars, in the theatres, in your business, and especially in your own home—right in your own family.

They are said to be troubled with "nerves," a condition which is not considered serious, but admitted to be most annoying, especially to those who must associate with people who have "nerves."

"Nerves" is not a malady which manifests itself, as many people believe, in twitching muscles, trembling hands. These conditions are found only in advanced stages of Nerve Exhaustion.

The symptoms of Nerve Exhaustion vary according to individual characteristics, but the development is usually as follows: First Stage: Lack of energy and endurance; that "tired feeling." Second Stage: Nervousness; restlessness; sleeplessness; irritability; decline in sex force; loss of hair; nervous indigestion; sour stomach; gas in bowels; constipation; irregular heart; poor memory; lack of mental endurance; dizziness; headache; backache; neuritis, rheumatism, and other pains. Third Stage: Serious mental disturbances; fear, undue worry; melancholia; dangerous organic disturbances; suicidal tendencies; and in extreme cases, insanity.

If only a few of the symptoms mentioned apply to you, especially those indicating mental turmoil, you may be sure that your nerves are at fault—that you have exhausted your Nerve Force.

Perhaps you have chased from doctor to doctor seeking relief for a mysterious "something the matter with you." Each doctor tells you that there is nothing the matter with you; that every organ is perfect. But you know there is something the matter. You feel it, and you act it. You are tired, dizzy, cannot sleep, cannot digest your food and you have pains here and there. You are told you are "run down," and need a rest. Your doctor may prescribe a drug—a nerve stimulant or sedative. Leave nerve tonics alone. It is like making a tired horse run by towing him behind an automobile.

And don't be deceived into believing that some magic system of physical exercise can restore the nerves. It may develop your muscle but it does so at the expense of the nerves, as thousands of athletes have learned through bitter experience.

The cure of weak and deranged nerves must have for its basis an understanding of how the nerves are affected by various abuses and strains. It demands an understanding of certain simple laws in mental and physical hygiene, mental control, relaxation, and how to develop immunity to the many strains of everyday life. Through the application of this knowledge, the most advanced case of Nerve Exhaustion can be corrected.

I have made a life study of the mental and physical characteristics of nervous people, having treated more cases of "Nerves" during the past 25 years than any other man in the world; over 100,000 cases.



PAUL VON BOECKMANN

Author of *Nerve Force* and various other books on Health, Psychology, Breathing, Hygiene and kindred subjects, many of which have been translated into foreign languages.

The result of this vast experience is embodied in a 64-page book, entitled "Nerve Force," a book that is essentially intended to teach how to care for the nerves and how to apply simple methods for their restoration. It includes important information on the application of deep breathing as a remedial agent. The cost of the book is only 25 cents, coin or stamps. Address me—Paul von Boeckmann, Studio 169, 110 West 40th St., New York City.

This book will enable you to diagnose your troubles understandingly. The facts presented will prove a revelation to you and the advice will be of incalculable value whether you have had trouble with your nerves or not. Your nerves are the most precious possession you have. Through them you experience all that makes life worth living, for to be dull-nerved means to be dull-brained, insensible to the higher phases of life—love, moral courage, ambition, and temperament. The finer your brain is, the finer and more delicate is your nervous system, and the more imperative it is that you care for your nerves.

"Nerve Force" is not an advertisement of any treatment I may have to offer. This is proved by the fact that large corporations have bought and are buying this book from me by the hundreds and thousands for circulation among the employees—Efficiency. Physicians recommend the book to their patients—Health. Ministers recommend it from the pulpit—Nerve Control, Happiness. Never before has so great a mass of valuable information been presented in so few words. It will enable you to understand your Nerves, your Mind, your Emotions, and your Body. Over a million copies have been sold during the past fifteen years.

What Readers of "Nerve Force" Say:

"I have gained 12 pounds since reading your book, and I feel so energetic. I had about given up hope of ever finding the cause of my low weight."

A physician says: "Your book is the most sensible and valuable work I have ever read on the prevention of neurasthenia. I am recommending your book to my patients."

"Reading your book has stopped that dreadful feeling of FEAR which paralyzed my stomach and digestion."

"Your book did more for me for indigestion than two courses in dieting."

"My heart is now regular again and my nerves are fine. I thought I had heart trouble, but it was simply a case of abused nerves. I have re-read your book at least ten times."

"The advice given in your book on relaxation and calming of nerves has cleared my brain. Before I was half dizzy all the time."

"I have been treated by a number of nerve specialists, and have traveled from country to country in an endeavor to restore my nerves to normal. Your little book has done more for me than all other methods combined."



"The Boss Didn't Even Know My Name"

"He said my face was more or less familiar and he remembered seeing me around, but he didn't even know my name until the I. C. S. wrote him that George Jackson had enrolled for a course of home study and was doing fine work."

"Who's George Jackson?" he asked. Then he looked me up. Told me he was glad to see I was ambitious. Said he'd keep his eye on me."

"He did too. Gave me my chance when Frank Jordan was sent out on the road. I was promoted over older men who had been with the firm for years."

"My spare-time studying helped me to get that job and to keep it after I got it. It certainly was a lucky day for me when I signed that I. C. S. coupon."

How much longer are you going to wait before you take the step that will bring you advancement and more money?

It takes only a moment to mark and mail this coupon and send it to the International Correspondence Schools at Scranton. Isn't it better to do this today than to wait a year or five years and then wish you had?

Mail the Coupon for Free Booklet

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7669-D, Scranton, Penna.

Oldest and largest correspondence schools in the world. Without cost, please tell me how I can qualify for the position or in the subject before which I have marked an X:

BUSINESS TRAINING COURSES

- | | |
|---|---|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Advertising |
| <input type="checkbox"/> Personnel Organization | <input type="checkbox"/> Better Letters |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Show Card Lettering |
| <input type="checkbox"/> Business Law | <input type="checkbox"/> Stenography and Typing |
| <input type="checkbox"/> Banking and Banking Law | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Accountancy (including C.P.A.) | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> Nicholson Cost Accounting | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Common School Subjects |
| <input type="checkbox"/> Private Secretary | <input type="checkbox"/> High School Subjects |
| <input type="checkbox"/> Spanish | <input type="checkbox"/> Illustrating |
| <input type="checkbox"/> French | |

TECHNICAL AND INDUSTRIAL COURSES

- | | |
|---|--|
| <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Architect |
| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Architects' Blueprints |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Contractor and Builder |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Architectural Draftsman |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Concrete Builder |
| <input type="checkbox"/> Railroad Positions | <input type="checkbox"/> Structural Engineer |
| <input type="checkbox"/> Gas Engine Operating | <input type="checkbox"/> Chemistry |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Automobile Work |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Airplane Engines |
| <input type="checkbox"/> Metallurgy | <input type="checkbox"/> Agriculture and Poultry |
| <input type="checkbox"/> Steam Engineering | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Radio | |

Name.....
Street.....
Address.....

City..... State.....

Occupation.....
If you reside in Canada, send this coupon to the International Correspondence Schools Canadian Limited, Montreal

PATENTS

Trade-marks, Copyrights, Patent Litigation. Handbook with illustrations, 100 mechanical movements. Sent free on request.

ALBERT E. DIETERICH

Formerly member Examining Corp. U. S. Patent Office
Patent Lawyer and solicitor.
27 years' experience

681-A Ouray Bldg., Washington, D. C.

PATENTS

BOOKLET FREE HIGHEST REFERENCES
PROMPTNESS ASSURED BEST RESULTS

Send drawing or model for examination
and report as to patentability

WATSON E. COLEMAN, Patent Lawyer
644 G Street N.W., Washington, D. C.

Inventive Genius on the Gridiron

(Continued from page 11)

lined with felt and harnessed together fore and aft with straps, also lined with felt, and so on. Also, certain imaginative gentlemen tacked on other utilities to fit their own particular style of play.

FOR instance, Harvey Woodruff, who made Pennsylvania famous with his "guards back" formation for rending an opposing line, happened on a bright idea for promoting cohesion in his particular style of attack. His contribution was a set of handles, much like the handles on an ordinary flatiron, except that they were made of several plies of canvas, securely sewed on the hips of the players' pants. When the attack was launched, the man carrying the ball grabbed a handle on a lineman ahead, the other backs grabbed the runner in like manner, and there was a merry pull and haul. It was permissible to push and drag a man along in those days as long as you could keep going.

But the introduction of the forward pass with a more open game, brought corresponding changes in equipment. More and more of a premium came to be placed on speed and agility, and it was found logical to dress the part. Away went nose guards and, in a good many cases, headgears as well. The urge for speed also prompted lighter dress. The old moleskins that had soaked up water like a sponge on a rainy day, gave place to the canvas of the earlier days.

THEN came "Pop" Warner with another of his clever ideas. Warner decided that the extra weight represented by several gallons of water soaked up by the men's clothes on the field was an unnecessary handicap. After considerable experimenting, he found a kind of leatherette material that appeared to suit his purpose. This he took to a well known firm of sports equipment manufacturers. The firm agreed to make a few sample pairs of breeches, and the spacious form of "Pop" himself was taken as a model. When the samples were finished, they were shipped to Warner at his farm near Buffalo, and there he gave them their first actual test.

He scooped out a big hole in the ground, spaded up the dirt, and then ran it partly full of water, forming a fairly close approach to a first class hog wallow. Then he donned the new garb and sloshed around in the mud until the pants were thoroughly covered. After this, he turned a hose on them and, presto! in a minute they were thoroughly clean and apparently no heavier than when he first put them on. With his team equipped with these "leather britches," all a coach has to do nowadays between halves of a game on a rainy, muddy day, is to have his men strip off their jerseys, turn a hose on them, provide them with clean dry jerseys, and send them back to the field in as good trim as they were when they started the game.

(Continued on page 159)

BE A RAILWAY TRAFFIC INSPECTOR

EARN UP TO \$250 PER MONTH EXPENSES PAID

MEN WANTED!

Advancement rapid with experience. A new, uncrowded profession with big opportunities. Pleasant, outdoor work. Travel or remain near home. Report to high railway officials.

POSITIONS OPEN—MUST BE FILLED

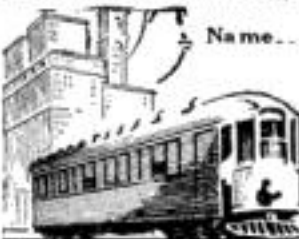
We secure position for you, upon graduation, paying at least \$110 per month and expenses or refund your money. You can easily prepare in 3 mos. spare-time home study.

Hundreds of successful graduates. Mail coupon today.

Standard Business Training Inst.,

Buffalo, N.Y.

* Send me, entirely free, Booklet No. D-64, giving full particulars about course in Railway Traffic Inspection.



Name.....

Street.....

City.....

State.....

YOU Can Be a Dental Laboratory Expert

Make Up to \$150 a Week

BOTH MEN AND WOMEN IN DEMAND
PERSONAL INSTRUCTION to Each Student



In One Big School for Mechanical Dentistry. The only school of its kind. Students are taught on Patients' work that is actually used. Only Modern Methods Taught. Thousands of Dentists need Laboratory Experts.

Stivison Trained Graduates

Always in Demand. Jobs Hunt You. Every Dentist does Laboratory Work that he would gladly have done by an Expert and pay Big Prices.

Real Dentist's Tools

are furnished and Instructions given by Real Dentists on work that Dentists need. Descriptive illustrated Book Free. We pay your R. R. Fare to Kansas City and assist you in paying your tuition. Earn while you Learn. GET IN THE BIG PAY CLASS

Write for Special Offer. Delay may cost you a good job and lots of money.

Stivison Dental Institute
500 McMillen Bldg., Kansas City, Mo.

WANTED—MEN TO LEARN RADIO



Experts Earn \$75 to \$200 a Week

Right now, everywhere, big, easy money is being made in Radio. Field unlimited. You can master Radio quickly at home in spare time. No previous experience necessary. Now is the time to enter this new, uncrowded field.

1,000 Mile Receiving Set Given

With the Course—Our new home-study methods make everything about radio amazingly simple. No other course like it. Makes you expert on radio operation, repairs and installations of all kinds. Send for literature telling all about opportunities and how we give 1,000 mile receiving set with the course. Don't miss this big offer—ACT. Write now for big free book.

Radio Association of America

4513 Ravenswood Ave. Dept. 410 Chicago



CHICAGO TECHNICAL COLLEGE
[22nd YEAR]

Intensely practical training in Drafting and Engineering—civil, mechanical, electrical, structural—Architecture. 2 year Diploma; 3 year B.S. Degree; special short courses. Courses adapted to your needs. No time wasted. Instructors are experts. Our graduates are in constant demand. Opportunities for part-time work while studying. Day and evening classes. Athletics. Enter anytime. Low tuition—easy terms. Write for 52-page illustrated Blue Book, describing opportunities open to our graduates. Chicago Technical College, N-51, Chicago Tech. Building, Chicago, Ill.



Can You Fix It?



Repair any auto fault, learn how NOW. You can do it easily in this new simple way. These FIVE Big Books are up to the minute on automobile engineering subjects; chock full of little known facts about construction, operation and repairs. Electric wiring treated in complete detail—illustrations and diagrams make everything clear and easily understood by anybody. The most interesting and most practical set of books ever written on modern automobile engineering. Whether you want to fit yourself for garage owner, repair expert or merely wish to know more about your own car, you will realize the value of these splendidly bound volumes.

NO MONEY OFFER

An amazing new plan of distribution brings these books to you for examination without one cent of payment to us. We don't ask a penny of you, but ship the books to you FREE. Look them over—read them as much as you want to; note the splendid photographs and drawings and then if you decide you want them, send us \$2.00, then only \$3.00 a month until only \$19.80 is paid. That is all; nothing more to pay us. If you send NOW we will include

Consulting Membership—INCLUDED

Yes, we actually give you a certificate which entitles you to free consultation on any subject related to automobile repairing. 18 specialized experts are at your disposal—ready at any time to help you. With this library and this consultation membership you ought to be able to soon know all there is to be known about autos. Don't miss this special offer. Send now.

AMERICAN TECHNICAL SOCIETY,
Automobile Division A720a, Chicago, Ill.

You may send me your complete Automobile Engineering library, 5 big volumes bound in flexo covers, with the understanding that I am to have ten days to decide if I want to keep them. I will either return them then or send you \$2.00 then and \$3.00 per month until the special low price of only \$19.80 is paid.

Name.....
Address.....
City..... State.....
Employed by.....

Play the HAWAIIAN GUITAR
Just as the Natives Do

FREE when you enroll
\$15 HAWAIIAN GUITAR and Case

Only 4 Motions used to playing this fascinating instrument. Our native Hawaiian instructors teach you to master them quickly. Pictures show how. Everything explained clearly.

Play in Half Hour
After you get the four easy motions you play harmonious chords with very little practice. No previous musical knowledge necessary.

Easy Lessons
Even if you don't know one note from another, the 62 printed lessons and the clear pictures make it easy to learn quickly. Pay as you play.

Free Guitar
and Outfit in Genuine Seal Grain Fabricoid Case as soon as you enroll. Nothing to buy—everything furnished. No delay.

Write at Once
You'll never be lonesome with this beautiful Hawaiian Guitar. Write for Special Offer and easy terms. A postcard will do. ACT!

FIRST HAWAIIAN CONSERVATORY OF MUSIC, Inc.
9th Floor, Woolworth Bldg., Dept. 146 New York, N. Y.
Approved as a Correspondence School Under the Laws of the State of New York

Learn to Mount Birds

Learn at home to mount birds, animals, game heads; tan furs, make rugs and robes. Complete lessons. Easily and quickly learned by men, boys and women.

FREE Write for Free Taxidermy Book. Tells all about it. Every sportsman, trapper and Nature lover should know this wonderful fascinating art. Save your trophies. Big profits. Success guaranteed. 75,000 graduates. Investigate. Write for Free Book.

Northwestern School of Taxidermy 1787 Elwood Bldg., Omaha, Neb.

Inventive Genius on the Gridiron

(Continued from page 158)

In the open game of today, knees and thighs are the targets for more punishment than most any other parts of the player's anatomy.

Knee padding has been in vogue for many years, but it remained for Coach Spears of West Virginia to solve a problem that had puzzled for a long time. Formerly, football pants were so padded at the knees as to place the protection in place only while the player was standing. But much of his time is spent kneeling or crouching down. Spears has devised a shallow leather cup, felt-lined, which is so attached that it covers the knee cap completely at all times.

One of the latest and most elaborate appliances for helping in the training of a football team is a tackling apparatus patented by Charlie Moran, National League baseball umpire and coach of the Bucknell eleven. Moran's invention comprises an extensive framework from which are suspended dummies in such manner that they can be shifted to simulate the defense of any team that the users may expect to meet. The arrangement further permits setting the dummies in motion as the team starts its play, so as to have them in the approximate positions to which actual players would be expected to shift.

FOR all the sundry protective devices worked out, the game still takes its toll of injuries.

At the Kansas State Agricultural College, football players last season were given baths of ultra-violet light as part of their training. This treatment has been especially effective in ridding players of boils, on account of the light's great power as a germicide.

But baths of the light are given these players, too, to build up their strength and fighting qualities, and victory in more than one important contest has been imputed to the treatment. Recent research indicates that ultra-violet light helps in building up new red blood corpuscles. With a team battered to pieces, and another game scheduled for the coming week, a way to speed up the manufacture of red blood may decide the score. This innovation of light treatments in Kansas is an indication of how coaches are availing themselves of the very latest in scientific research.

Ovens for baking out swollen joints, liniments and lotions for removing soreness and the like are all a part of the equipment of a big college team nowadays. Also, a brace for refractory knees has been devised which will enable a player, who otherwise would be relegated to the side lines, to scamper on the field and cut surprisingly active capers. Yes, and a few years ago, a brace was devised that enabled Eddie Hart, hard-plunging fullback of the Princeton Tigers, to rip through opposing lines although he carried a fractured vertebra in his neck.

Such necessity-born artifices of science and invention have had quite a hand in making possible the annual thrills on the gridirons throughout the country.

"I aint"
"He don't"
"It's me!"
"You was?"
"Can't hardly"



What Are YOUR Mistakes in English

They may offend others as much as these offend you

IF someone you met for the first time made the mistakes in English shown above, what would you think of him? Would he inspire your respect? Would you be inclined to make a friend of him? Would you care to introduce him to others as a close friend of yours?

These errors are easy for you to see. Perhaps, however, you make other mistakes which offend other persons as much as these would offend you. How do you know that you do not mispronounce certain words; are you always sure that the things you say and write are grammatically perfect? To you they may seem correct; but others may know they are wrong.

Unfortunately people will not correct you when you make mistakes; all they do is to make a mental reservation about you. "He is ignorant and uncultured," they think. So you really have no way of telling when your English offends others.

FREE Book on English and 15-Minute Test

Sherwin Cody, perhaps the foremost teacher of English in the country, has prepared a simple 15-minute English test which you can take in your own home. This test, with the answers which will also be sent, tells you at once just where you stand. You can discover at a glance whether you make even slight errors. Give yourself this test. If you are efficient in English, it will give you greater confidence; if you are deficient, you surely want to know it, so that you can correct your mistakes.

Mr. Cody's remarkable new invention, the 100% Self-Correcting Method, has already improved the English of more than 41,000 people. No useless rules, no tedious copying, no hard study. Only 15 minutes a day required. You learn by creating the HABIT of using correct English. Nothing like Mr. Cody's method has ever been used before!

You do not want others to judge you unfairly. Write today for this test—it is free. We will also gladly mail you our new free book, "How to Speak and Write Masterly English." Merely mail the coupon or a postal card.

Sherwin Cody School of English
1810 Searle Building Rochester, N. Y.

Sherwin Cody School of English
1810 Searle Building, Rochester, N. Y.

Please send me your Free Book, "How to Speak and Write Masterly English," and also Mr. Cody's 15-minute Test of my English.

Name.....
Address.....
City..... State.....

PATENTS

TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.

PATENT ATTORNEYS

Associated since 1846 with the Scientific American

683 WOOLWORTH BUILDING
New York City

411 TOWER BUILDING
Chicago, Ill.

522 SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

364 HOBART BUILDING
San Francisco, Cal.

219 VAN NUYS BUILDING
Los Angeles, Cal.

Books and Information on Patents
and Trade Marks By Request.
Associates in All Foreign Countries.

Snares for Inventors

(Continued from page 20)

turer but one paid royalties to Selden. Henry Ford was not granted a license, and when he began shipping machines in 1903, he went ahead without paying royalties.

Selden sued, and the first court decision sustained the patent. On an appeal, the decision held that the principal claim was limited to a two-cycle gasoline engine. The four-cycle engine had not been in general commercial use when the patent was applied for. Ford and most of the other manufacturers had used a four-cycle engine from the beginning, and the Federal courts decided that the Selden patent didn't cover that in the combination. Half a million dollars was spent in this litigation.

The Selden patent was based on what are known as "combination claims," in which the invention consists of a new way of combining elements that already are known, to produce a new result. Most patents are issued on combination claims, because it is only rarely that anybody discovers something absolutely new. And a patent based on combination claims is no protection to the inventor if the device can be made to work by omitting any single element of the combination.

AN INVENTOR got a patent on a device to use in coal stoves to enable them to burn kerosene as fuel. It was a new idea and should have made him a fortune. Unfortunately, in drawing up the claims he had included in all of them a groove to catch any dripping of oil. As soon as the device was on the market and making money, a clever young man bought one, filled up the groove and found it would work just as well. Then he duplicated the device, all but the groove, and the courts held that the inventor had no redress. He had claimed more than he needed.

"However, most of the pitfalls that confront the inventor are of his own digging," said one of the foremost of American patent attorneys. "I am speaking now of the amateur inventor, and nearly all inventors are amateurs."

"The amateur is full of fear that somebody will steal his invention. He need have no such fear if he protects himself with documentary evidence of the date of the original conception of his invention and of each stage of its development. He should also have a reliable attorney search Patent Office records to see if the invention is really new. And, most important, he ought to make sure that there is a possible market for the device."

"That is the way the professional inventor works. He usually discovers the demand and then sets to work to supply it. Nine times out of ten he sells his invention before he applies for his patent, letting the purchaser get the patent while he turns his mind to another problem."

"The amateur nearly always demands a flat sum in cash—a million dollars is a favorite amount to ask. The professional, on the other hand, knows that an invention, no matter how useful, must be developed and commercialized and gen-

(Continued on page 161)

U.S. PATENTS



DON'T LOSE YOUR RIGHTS TO PATENT PROTECTION

Before disclosing your invention to anyone send for blank form "EVIDENCE OF CONCEPTION" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish the same before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the United States and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception," sample, instructions relating to obtaining of patents and schedule of fees sent upon request. Ask for them,—a post card will do.

PATENTS AND TRADE MARKS
LANCASTER & ALLWINE
Registered Patent Attorneys in U. S. and Canada

274 Ouray Bldg.
WASHINGTON, D. C.
Originators of forms "Evidence of Conception."

PATENTS

To the Man With an Idea

I offer a most comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
Patent Lawyer

6 Owen Building, Washington, D. C.
41-D, Park Row New York City

INVENTORS PROTECT YOUR IDEAS

Send for our Guide Book, **HOW TO GET A PATENT**, and Evidence of Invention Blank, sent Free on request. Tells our terms, methods, etc. Send model or sketch and description of your invention for **Inspection and Instructions Free**. Terms Reasonable. Best References.

RANDOLPH & CO.
Dept. 130, Washington, D. C.

NAME.....
STREET.....
CITY..... STATE.....

Snares for Inventors

(Continued from page 160)

erally sells on a royalty basis, with a stipulation that his invention must be put on the market within a specified time or it reverts to him.

"Marketing an invention, even a good one, isn't always easy. Usually the market exists in the industry to which the invention pertains, but not always. The inventor of a new kind of soft collar, made of a special weave, met nothing but rebuffs from the collar industry. He finally interested some outside capital. Now the collar people all are making soft collars and already have had to pay several millions in royalties.

"Every railroad man, almost, has an invention or two to improve railroading, but few ever are adopted, because to do so would mean rebuilding an entire railway system. Costs entailed are out of proportion to the value of the invention. Even so simple a device as a self-locking nut for track bolts, which almost every trackwalker invents, would cost hundreds of thousands of dollars to adopt.

"**REVOLUTIONARY**, basic inventions are the hardest to sell, though they bring the best prices when sold. Let the inventor beware, however, of selling to an irresponsible or under-capitalized company. The most profitable inventions generally are improvements on existing devices that make them either better or cheaper; and these inventions usually are made by men familiar with the needs and weak spots of the particular industry. Yet bright amateurs sometimes do find the things that professionals have been racking their brains over for years. Remember that Fulton, the inventor of the steamboat, was an artist, as was Morse, who invented the telegraph; Bell, of telephone fame, was a school-teacher, and you have a vision of the possibilities."

Machine Works Rapidly

SIX thousand reproductions of typed pages, printed pages, pen-and-ink drawings, or prints of woodcuts can be made in an hour, it is claimed, with a new duplicating machine called a "rotaprint," invented in Germany. Steel engravings, also, can be reproduced, and the machine is adapted for architectural drawings and sheet music. Colors will reproduce one at a time.

In the case of typed material, a stencil is made first, as for a mimeograph, and this sheet smeared with a chemical preparation is passed through a series of rollers, after which prints can be made.

Experiments in Balloon

A BALLOONIST recently experimented to determine the distances at which he could hear various sounds. He could hear a man's shout at 1600 feet; frogs' croaking at 3000 feet; orchestra music at 4500 feet; church bells at 5000 feet; a rifle report at 5900 feet; and the noise of a moving train at 8200 feet. The whistle of a locomotive was heard farthest at 10,000 feet.

PATENTS TRADE-MARKS AND COPYRIGHTS

Have You An Idea? Our Offer: FOR THE PROTECTION OF YOUR INVENTION YOUR FIRST STEP



Before disclosing an invention the inventor should write for our blank form

"RECORD OF INVENTION"

This should be signed and witnessed and returned to us together with model or sketch and description of the invention for

INSPECTION and INSTRUCTIONS

No Charge for the Above Information

Our Four Books Mailed Free to Inventors

Our Illustrated Guide Book

HOW TO OBTAIN A PATENT

Contains full instructions regarding U. S. Patents. Our Methods, Terms, and 100 Mechanical Movements illustrated and described.

OUR TRADE MARK BOOK

Shows value and necessity of Trade Mark Protection. Information regarding Trade Marks and unfair competition in trade.

OUR FOREIGN BOOK

We have Direct Agencies in Foreign Countries, and secure Foreign Patents in shortest time and at lowest cost.

PROGRESS OF INVENTION

Description of World's Most Pressing Problems by Leading Scientists and Inventors

IMPORTANT

TO MAKE YOUR CASE SPECIAL AND AVOID DELAY YOU SHOULD HAVE YOUR CASE MADE SPECIAL IN OUR OFFICE to secure protection, save correspondence and obtain early filing date in Patent Office. To secure special preparation of your case send \$25.00 on account with model, or sketch and description.

All Communications and Data Strictly Confidential. Interference and Infringement Suits Prosecuted. Our Organization offers PERSONAL SERVICE by Experienced Patent Solicitors and Draftsmen.

We regard a Satisfied Client as our best advertisement, and furnish anyone, upon request, lists of clients in any state for whom we have secured patents.

Highest References—Prompt Attention—Reasonable Terms

WRITE TODAY

Free
Coupon

VICTOR J. EVANS & CO.

Patent Attorneys

New York Offices 1007 Woolworth Bldg. Philadelphia Offices 714-715 Liberty Bldg. Pittsburgh Offices 514 Empire Bldg.
Chicago Offices, 1114 Tacoma Bldg. San Francisco Offices, Hobart Bldg.

Main Offices: 760 Ninth Street, Washington, D. C.

Gentlemen: Please send me FREE OF CHARGE your books as described above.

Name.....Address.....

Opportunities for Readers in Quick Action Advertising

ADDING MACHINES

FREE trial, marvelous new adding machine. Adds, subtracts, multiplies, divides automatically. Work equals \$350.00 machine. Price only \$15.00. Speedy, durable, handsome. Five-year guarantee. Used by largest corporations. Write today for catalog and free trial offer. Lightning Calculator Co., Dept. O, Grand Rapids, Michigan.

ADVERTISING SERVICES

ADVERTISE in 24 metropolitan dailies, 24 words, \$15.00. Helpful Guide listing 1000 publications, 4c stamps. Wade Company, Baltimore Bldg., Chicago.

24 WORD ad 355 rural weeklies, \$14.20. Ad-Meyer, 4112P Hartford, St. Louis.

CIRCULARIZE guaranteed lists. Agents' names \$5.00, 1,000. Pennell, Covington, Ky.

COMBINATION Winner. 125 Magazines, 10c word, \$8.00 inch. Thrice, Interstate Advertiser, Muncie, Mich.

ADVERTISING in all magazines and newspapers at publishers' lowest rates. Rate book free. Taylor's Advertising Service, Dept. 5, Freeport, Ill.

INCH display, 88 magazines \$2.00, thrice \$5.40. Smith's Service, Waukegan, Wis.

STRONG copy based on sound plans. Outline your project for free analysis and plan. S. Wycross Co., Lansdowne, Penna.

AUTHORS AND MANUSCRIPTS

PHOTOPLAY—Story Ideas wanted. \$25-\$500 paid. Experience unnecessary; outline free to anyone. Write Producers League, 312 St. Louis.

WRITERS—Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 117, Hannibal, Missouri.

\$\$\$ FOR Ideas. Photoplay plots accepted any form, revised, criticized, copyrighted, marketed. Advice free. Universal Scenario Corporation, 214 Security Bldg., Santa Monica and Western Avenue, Hollywood, California.

I WANT song poems. Casper Nathan, J-3544 No. Racine, Chicago.

SONG Poem Writers send for proposition. Ray Hibbeler, D10, 4040 Dickens Av., Chicago.

SHORT Stories, Articles, etc., typewritten and marketed. Hursh Service, Dept. 3, Box 1013, Harrisburg, Penna.

SONGS and song poems wanted. Radio Publicity Bureau, Box 24, Times Square Station, New York.

AUTOMOBILES AND ACCESSORIES

DELIVERY bodies for Ford Model T Chassis with inclosed cab, suitable for Contractors, Grocersmen and Farmers. Three styles. Price \$37.50. Write Daniel Zimmerman, Craigville, Indiana.

OLD spark plugs rebuilt. Guaranteed same as new. Standard makes. 30c each. We also buy old worn-out plugs. For particulars write, B. S. Salvage Co., 46 West Kinney St., Newark, N. J.

AUTO Body Polish, make your own, gallon costs less than pint bottle, formula \$1. bill; Kemo Sales Co., 1452 East 118 St., Cleveland, Ohio.

AVIATION

The American School of Aviation announces a new correspondence course in mechanics of aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 6741, 3601 Michigan Ave., Chicago, Illinois.

BOYS fly this three-foot model aeroplane. Small cost. Write for circulars. Aero Shop, 3050 Huribut Ave., Detroit, Mich.

LEARN Flying Right. America's Largest Strictly Commercial Organization. High class individual instruction without restrictions. Write for further particulars. Johnson's Flying Service, Inc., Dayton, Ohio.

DO you want a position where you can pay your way while learning to qualify as airplane mechanic or pilot? Send \$2.00 for one yearly subscription to Slipstream Monthly—The Flyers' Magazine and our employment service will help you get located. Only subscribers need apply. Slipstream Publishing Co., Dayton, Ohio.

BLUEPRINTS

TO the man who has a Home Workshop and likes to work with tools, Popular Science Monthly offers the opportunity to purchase blueprints giving details of the construction of useful articles for the home. The following are a few of the blueprints available: No. 1, Sewing Table, No. 5, Kitchen Cabinet, No. 13, Tea Wagon, No. 15, Workshop Bench, No. 17, Cedar and Mahogany Chest, No. 41, One Tube Radio Set, No. 42, Radio Receiver with three stages of amplification, No. 43, Four Tube Radio Receiver. Send 25c for each blueprint that you wish to Popular Science Monthly, 242 Fourth Avenue, New York, N. Y.

BOATS AND LAUNCHES

BOATS that always go are propelled by Ford engines. Ford dope free to boat owners. Harry Rider, East Norwalk, Conn.

BOAT-BUILDING Plans for amateurs. Rowing, sailing, speed, cruising. Free catalog. The Rudder, 9 Murray Street, New York.

BRANCH OFFICE SERVICE

WASHINGTON mail address \$5 month. Established 1920. Address "Service", 605 District National Bank Building, Washington, D. C.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

Rate 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive insertions. Advertisements intended for the Dec. issue should be received by Oct. 5th

Prize Winners in Last Month's Contest

THE first prize of \$10.00 goes to Cecil H. Brown of Los Angeles, California, for his letter on Haywood's advertisement. Here is Mr. Brown's letter:

Dear Sir:

After carefully reading all the advertisements under "Money Making Opportunities," Haywood's ad with reference to operating a tire shop interested me most, as I have a friend who is just starting a small auto repair shop and wishes to learn tire repairing as a side line in connection with his auto repair shop.

I gave him Haywood's ad and he is going to write them.

Respectfully yours,

Cecil H. Brown.

Mr. John P. O'Connor, New Haven, Connecticut, wins the second prize for the following letter on the advertisement of C. C. Collette Manufacturing Company.

Dear Sir:

The advertisement that interested me most was that of the C. C. Collette Mfg. Co., Amsterdam, New York, who employ agents to sell their product.

This "Money Making Opportunity Advertisement" has enabled me to connect with a concern manufacturing a "live wire" seller.

I have now found that the advertising columns of POPULAR SCIENCE MONTHLY sure are full of "live wire" advertisements from "live wire" concerns.

Respectfully submitted,

John P. O'Connor.

The third prize goes to Mr. G. D. Reynolds of Altoona, Pa., for his letter regarding the Auto Accessories advertisements. This is the letter:

Dear Sir:

I am a direct-to-consumer salesman of household specialties. I drive my own car; needless to say I drive it long and hard. Consequently I was interested in the Vapor Humidifier advertised by Critchlow. Its use has considerably lowered my selling expense with a commensurate increase in profits. And it sells itself to fellow salesmen. I'm not much of a judge of mechanical contrivances—but my motor is!

Yours truly,

G. D. Reynolds.

The winners of the other seven prizes and the names of the advertisers they wrote about are:

George F. Aiken, East Providence, R. I. (Universal Scenario Corporation)

Mrs. A. Graham, Independence, Iowa (American Photography)

Mr. A. Letcher, Tucumcari, N. Mexico (E. E. Palmer)

Robert H. Harper, Butler, Missouri (W. Hillyer Ragsdale Specialty Candy Factories)

Glen W. Naves, (Scouting Equipment)

Miss Louise Kenyon, Westerly, R. I. (Theander Novelty Company)

Adele M. Clardy, Lavoie, Wyoming (American Photography Camera House)

Announcement

You will find on Page 4 of this month's issue a NEW prize contest offering \$100 in Cash Prizes for the best letters on the advertisements in the Money Making Opportunities Section.

BUSINESS OPPORTUNITIES

WE start you in business, furnishing everything; men and women, \$80.00 to \$100.00 weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime; booklet free. W. Hillyer Ragsdale, Drawer 19, East Orange, N. J.

GOLD, Silver, and colored Sign Letters for windows, automobiles, trucks. Make them yourself with our Process and Letter Patterns. Fast sellers. Big profits. No experience. Stamp brings actual sample. Withering, 1144 Pleasant Street, Oak Park, Illinois.

GET into line with Gilbert's House Wives' necessities, good profits, easy sellers, Six Samples \$1.00. Gilbert Sale Co., Box 26-K, Milford, Conn.

FREE Book. Start little mail order business. Pier, 976 Cortlandt Street, N. Y.

LEARN the collection business. Good income; quick results. Interesting booklet, "Skillful Collecting," free. National Collector's Association, Science Building, Newark, Ohio.

BECOME a Foot Correctionist. A New Profession not medical nor chiropody. All the trade you can attend to; many are making \$3000 to \$10,000 yearly, easy terms for training by mail, no further capital needed or goods to buy, no agency or soliciting. Address Stephenson Laboratory, 10 Back Bay, Boston, Mass.

MIRRORS re-silvered at home. Costs less than 5 cents per square foot; you charge 75 cents. Immense profits, plating auto parts, reflectors, tableware, stoves. Refinishing metal ware, etc. Outfits furnished. Write for information. Sprinkle, Plater 94, Marion, Indiana.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

"SUCCESSFUL" Mail Order Business! Details, 25c! Surety Service, 551 Harvard St., Rochester, N. Y.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

SOMETHING new in the Mail Order Business. Starts you in business right at home. No part time, or house to house methods. Station A, Box No. 6, San Diego, California. H. N. Allison.

INCH Display Advertisement, 100 Magazines, year, \$50.00. Woods Popular Service, Atlantic City.

PATENTS procured; Trade Marks Registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Bldg., Washington, D. C., or 41-Z Park Row, New York.

MAKE big income operating a collection agency. No capital necessary. We teach you fully. Write Collection Instruction Institute, 313 Waverly, Syracuse, N. Y.

STOP plodding! Be successful. Operate a tire repair shop. Make big profits in any locality. We teach you and furnish complete equipments, \$100 up. Book of Opportunity free. Haywood's, 1306 South Oakley Avenue, Chicago.

START small home Mail Order Business. Booklet 2c. Harvey Teeple, Decatur, Indiana.

START for yourself. Be independent. We show you how. The mail order way. Send \$1.00 for instructions. Dp. 131. E. Noon, Windsor, Va.

\$50 A week evenings. Mail Order Business. Booklet tells how. Sample and plan 25c. Free—9 articles worth \$3. P. Bradford Co., Shawnee, Okla.

WHY work for others? Mirror Resilvering Simplified. Book of instructions 25c prepaid. C. W. Steene, Mirrors and Glass, 230 East Water St., Syracuse, N. Y.

FREE Booklet describes 52 plans for making \$20.00 to \$100.00 weekly in home or office business of your own. Downs Co., 2328 Myrtle, St. Paul, Minn.

MANUFACTURE Dry Chemical Fire Extinguisher, big profits, demonstration makes sure sales. Formula \$1.00. OGA, Co., 3 Ocean Way, Long Beach, Cal.

PATENTS commercialized, D. C. S. Auto Products Co., Indianapolis, Indiana.

DON'T buy a business. Start one yourself. Small capital. Information Paul Kaye, 149 Broadway, N. Y., Dept. R.

THE Great Wheat Secret. New book showing the cause of wheat swings and how to forecast them. Unequaled method for traders, speculators, millers. Eye-opening folder free; write today. Market Forecaster Co., Dept. B., Box 174, Topeka, Kansas.

LEARN Furcraft—Big Profits waiting in every community. Easily learned at home in your spare time. Get into a high-grade business for yourself. Uncrowded field. No peddling or soliciting. We teach you how. Be first. Write today for free book and full particulars. Enclose 5c stamps, mailing cost. No obligation. Northwestern Fur Co., Suite 9787, Sunderland Building, Omaha, Neb.

BUSINESS Guide with free legal service sells everywhere. Wells cleared \$1,185 in 35 days. Write for free outfit. Nichols Co., Naperville, Ill., Dept. 1P.

IF you really want to make money, get my proposition right NOW. Russell Johnson, Clarkfield, Minn.

\$100 WEEKLY, income starts immediately, particulars free. Dr. Abell, 141 The Arcade, Cleveland, Ohio.

BATTERY shop equipment and supplies at wholesale. Adams-Barrs, Columbus, Ohio.

OPPORTUNITY seekers—\$200 monthly in spare time business. 52 plans free. Busy Bee, 154 East 170th St., New York.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

Men! Here's a Contract



NEW HAIR in 30 Days Or Absolutely No Cost

Save Yourself From Baldness. Stop Falling Hair. Here Is Your Contract—Grow New Hair in 30 Days Or This Trial Won't Cost You One Cent

By ALOIS MERKE

Founder of Famous Merke Institute, Fifth Avenue, New York

THAT'S clear, isn't it? I make no conditions. No matter how fast your hair is falling out, no matter how much of it is gone—this offer stands. I don't care what treatments you have tried without results. Scalp foods, massages, tonics—here is a new scientific system that will give you a new head of hair—or I pay the whole cost of the treatment myself.

How am I able to make this amazing offer? The answer is simple. The Merke System of hair growth is founded upon a very recent scientific discovery. I have found during many years of research and experience in the Merke Institute, Fifth Avenue, New York, that in most cases of baldness the hair roots are NOT dead. They are merely dormant—asleep!

It is an absolute waste of time—a shameful waste of money—to try to penetrate to these dormant roots with oils,

massages and tonics, which merely treat the surface skin. You wouldn't expect to make a tree grow by rubbing "growing fluid" on the bark—you'd get at the roots.

And that is just what my scientific system does. It penetrates *below* the surface of the scalp. It stimulates the dormant roots. It awakens them. The tiny capillaries begin to pump nature's own nourishment into them. Hair begins to grow again. It takes on body and color. No artificial hair foods—no rubbing. And here's the wonderful thing about this system. It is *simple*. You can use it at home—in any home that has electricity—easily—without the slightest discomfort.

This Is Your Bona-Fide Contract

Thousands of men and women have been treated successfully at the Merke Institute. Hundreds daily are getting amazing results with this easier, less expensive "at

home" system of hair growth. Now, I do not say that all cases of baldness are curable. There are some that nothing in the world can help. Yet so many men and women write in daily about the wonderful results that I gladly make this offer. Here is your contract—try this remarkable treatment for 30 days. Then, if you're not simply delighted with the new growth of hair—write me at once. Say that my system hasn't done all I claimed for it—and I'll see that the 30-day trial doesn't cost you one cent.

Free Booklet Tells All

There's no room here to tell you all about your hair—and about the amazing contract I offer you. But I will be glad to tell you all if you are interested. It's free—absolutely without any obligations. Just mail the coupon and I will send you, without cost, a wonderfully interesting booklet that describes in detail the system that is proving a boon to thousands in this and other countries. Mail this coupon and the booklet will reach you by return mail. **Allied Merke Institutes, Inc., Dept. 1710, 512 Fifth Ave., N. Y. C.**

Here's Proof!

"The condition of my hair was very bad. After six weeks' treatment with the Thermocap my head was covered with short hair and it was no longer dull and lifeless. I kept up the treatment and in return I have as good a head of hair as any one could wish." *Clarence Terpening, 158 South Cedar Street, Galesburg, Ill.*

"I used the Cap for 30 days when to my great surprise I could see a new coat of hair coming and now my hair is very near as good as it was when it first started to come out." *J. C. Regan, 176 West Street, Englewood, N. J.*

"Your Thermocap has done a wonderful thing in bringing back my hair where all other things had failed. The top of my head is now entirely covered with hair after using the Thermocap for about two months and new hair seems to be coming in all the time." *Harry A. Brown, 21 Hampton Place, Utica, N. Y.*

Allied Merke Institutes, Inc.,
Dept. 1710, 512 Fifth Ave., New York City.

Please send me—without cost or obligation—a copy of your book, "The New Way to Grow Hair" describing the Merke System.

Name.....

Address.....

City.....State.....

BUSINESS OPPORTUNITIES

YOUR ship will never come in unless you send it out. European Bonds, "The Venture of the Century," bought, sold, cash or installments. Information without obligation. Frank G. Everett, 35 Wall St., New York.

SUCCEED with your own products—make them yourself. Formulas, processes by experts. Trade secrets. Modern master methods. Catalog free. C. Thaxly Co., Washington, D. C.

RECEIVE \$20 daily, 96% profit, exact method we use, particulars for stamp. Danner, 1222 E. 49th, Los Angeles, Cal.

USED correspondence school courses. All kinds. Sold on re-purchase basis. Big saving. Money back guarantee. Lists free. (Courses bought.) Lee Mountain, Placah, Alabama.

ARE you old at forty? See our advertisement on page 143 of this issue. The Electro Thermal Company, 4050 Main, Steubenville, Ohio.

BUSINESS SERVICES

CHARTERS—Delaware; best, cheapest; granted day received; free forms. Colonial Charter Co., Wilmington, Del. (99)

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

CHALK TALKS

LAUGH producing program, \$1.00. Circulars free. Cartoonist Balda, Oshkosh, Wisconsin.

DISTRICT MANAGERS AND REPRESENTATIVES WANTED

WORLD'S fastest selling auto accessory! County distributors wanted; write to-day. G. L. W., Spring Offer Co., San Diego, California.

DISTRICT representatives. Marvelous opportunity selling Radiolite system of charging batteries to battery stations, garages, auto and radio owners. Wonderful discovery. Free sample. Exclusive territory going rapidly. Radiolite Co., St. Paul, Minn.

AGENTS our new co-operative plan, makes you a partner in our business and pays you profits, the same as stockholders, the most liberal plan in the United States to-day. \$25 to \$75 weekly easily made. B. & G. Rubber Co., Dept. 825, Pittsburgh, Pa.

DOGS

COLLIES for Sale. Training Book 35c. F. Clark, Bloomington, Ill.

EDUCATIONAL AND INSTRUCTION

USED correspondence school courses save over half. Bargain catalogue 1900 courses free. Used courses bought. Students' Exchange, Dept. A, 47 West 42d, Street, New York.

"DOUBLE entry bookkeeping mastered in 60 hours, with 8 keys; guaranteed; diploma." International Bookkeeping Institute, Desk 10, Springfield, Mo.

BOOKKEEPING in a week, \$2 complete. Dukes, 640 West 153d Street, New York.

FOR "Free Scholarship" (Mail Course), write Carnegie College, Rogers, Ohio.

CORRESPONDENCE Courses bought and sold. Handling, 799-X, Broadway, New York.

CORRESPONDENCE Courses sold complete: 1-3 usual prices because slightly used; easy terms; money back guarantee. All schools and subjects. Write for special Free catalog. Courses bought for cash. Economy Educator Service, 202-N, West 49th St., New York.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

FOR INVENTORS

INVENTOR'S Universal Educator—contains 900 mechanical movements; 50 perpetual motions. Tells how to obtain and sell patents. Suggests new ideas. Explains how to select your attorney and avoid patent sharks. Price (revised edition), \$2.00 postpaid. Albert E. Dietrich, 681 Ouray Bldg., Washington, D. C.

UNPATENTED Ideas Can Be Sold. I tell you how and help you make the sale. Free particulars (Copyrighted). Write W. T. Greene, 805 Jenifer Building, Washington, D. C.

PATENTS Sold; or placed on Royalties, for immediate action write Arthur S. Billings, Suite 401 Dekum Bldg., Portland, Oregon.

WANTED—Representatives in every factory in the United States, Popular Science Monthly, 250 Fourth Ave., New York.

I SELL Patents. Established in 1900. Charles A. Scott, 773PS, Garson Avenue, Rochester, New York.

IF you have a practical, useful invention to sell, write promptly. American Patents Corporation, Barrister Building, Washington, D. C.

INVENTIONS Commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 183 Enright, St. Louis, Mo.

MECHANICAL drawing. Difficult designs. Your ideas developed secretly, safely. Write Baskerville Engineers, Farley Bldg., Birmingham, Ala.

GET Cash for your patent or invention under our new plan. Write at once to Inventors' Syndicate, 23 Palladium Bldg., St. Louis, Missouri.

MR. INVENTOR: If you have a patent or invention for sale. Write Hartley, 44 Central St., Bangor, Maine.

GET Your Own Patents. Instructions, legal blanks, \$1. Cooper Cutting, Campbell, Calif.

FOR MEN AND WOMEN

DETECTIVES—Work home or travel. Experience unnecessary. Write, George Wagner, former Government Detective, 1968P Broadway, N. Y.

ARE you old at forty? See our advertisement on page 143 of this issue. The Electro Thermal Company, 4050 Main Street, Steubenville, Ohio.

GENUINE Indian Made Baskets, Blankets, Wampum. Catalog. Gilham, Kelseyville, Calif.

FORMULAS

FORMULAS: your favorite beverages, syrups, flavors, extracts, etc., Others. Free information. The Formula Co., West Howe at Second, Seattle, Wash.

ANY one formula, 25c. Pittman Laboratory, Formula Dept., Parkville, Kentucky.

FOR SALE AND EXCHANGE

FOR Sale: Watchmaker's Lathe at a bargain. R. Jaegermann, 5815 Easton Ave., St. Louis, Mo.

MR. MANUFACTURER. Layman or veteran—Side Dump Scraper Holst, loads wagons, does ditching. E. B. Hawkins, Applegate, Oreg.

FOR THE HOME

HOME Weaving—Looms only \$9.90. Big money in weaving Colonial rugs, carpets, etc., from rags and waste material. Weavers are rushed with orders. Send for Free Loom Book, it tells all about home weaving and quotes reduced prices and easy terms on our wonderful new looms. Union Loom Works, 482 Factory St., Boonville, N. Y.

GRANDFATHER clock works \$5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Penn.

WIRE your own home for electricity. It is easy. Save \$75—\$150. I show you how, loan you the tools, and can get you the material at wholesale prices. Service charge \$2. Your money back if not satisfied with plan. Eugene Parker, Putnam St., Peabody, Mass.

TO the man who likes to work with tools, Popular Science Monthly offers the opportunity to purchase blueprints giving details of the construction of useful articles for the home. The following are a few of the blueprints available: No. 1, Sewing Table, No. 5, Kitchen Cabinet, No. 13, Tea Wagon, No. 15, Workshop Bench, No. 17, Cedar and Mahogany Chest, No. 41, One Tube Radio Set, No. 42, Radio Receiver with three stages of amplification, No. 43, Four Tube Radio Receiver. Send 25c for each blueprint that you wish to Popular Science Monthly, 242 Fourth Avenue, New York, N. Y.

HELP WANTED

MEN to build radio sets in spare time. Leon Lambert, 555-D Kaufman Bldg., Wichita, Kansas.

SILVERING Mirrors, French plate. Easily learned immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Mo.

OUR genuine gold window sign letters are an excellent money-making proposition for handy men. Slann Sign System, East Bethune Avenue, Detroit, Michigan.

MR. BRUSH Salesmen—Old Established New York Brush Manufacturer requires the services of men in all territories to sell their extensive line of Sanitary Twisted Wire Brushes. We pay larger commissions than any other Brush House in the country. Write immediately for our proposition. Wire Grip Sanitary Brush Corp., 15 Mercer St., New York.

A PAYING position open to representative of character. Take orders shoes—hosiery direct to wearer. Good income. Permanent. Write now, Tanners Shoe Mfg. Co., 8-412 C St., Boston, Mass.

A REPRESENTATIVE wanted, take orders, rugs direct at mill prices. We deliver and collect. Exceptional opportunity now. Permanent weekly income. Seven wonderful quality rugs in sample case. Write Malsley-Payne Mfg. Co., 90-412, Boston, Mass.

HELP WANTED—INSTRUCTION

MEN 18 up. Be Railway Mail Clerks, Mail Carriers, Post-Office Clerks, \$1,700—\$2,700 year. Steady. Examination schedule—free. Write immediately. Franklin Institute, Dept. H-35, Rochester, N. Y.

MEN wanting forest ranger, railway mail clerk and other government positions, write for free particulars of examinations. Mokane, Dept. B-30, Denver, Colo.

DETECTIVES Earn Big Money. Excellent opportunity. Travel. Fascinating work. Experience unnecessary. Write George Wagner, former Government Detective, 1968P, Broadway, N. Y.

RAILWAY Postal Clerks, \$1900—\$2700; Postoffice Clerks, Carriers, \$1700—\$2300. Many other splendid opportunities. Thousands appointments annually. Information Booklet free. Chicago Civil Service College, T-226 Keener, Chicago.

RAILROAD Postal Clerks start \$155 month, railroad pass. Send stamps for questions. Columbus Institute N-2, Columbus, Ohio.

FIREMEN, Brakemen, Baggage-men, Sleeping car, train porters (colored) \$140—\$200. Experience unnecessary. 838 Railway Bureau, East St. Louis, Ill.

INCORPORATIONS

INCORPORATE Delaware. F. Lewis Mettler, 832 Market St., Wilmington, Del. (Established 1909.)

DELAWARE Incorporator. Charters: Fees Small; forms. Chas. G. Guyer, 901 Orange St., Wilmington, Delaware.

INFORMATION

COMPLETE, accurate information on any subject, \$2 National Information Bureau, 1429B Milton St., Grand Rapids, Michigan. Prompt service.

ADVICE from engineers will save you from making costly mistakes in buying radio and tool equipment. Write to Popular Science Institute, 246 Fourth Ave., New York City, for list of tested and approved products. See page 6.

INVESTMENTS

GERMAN bonds, unlisted. Obsolete securities marketed. Edwin Bailey, 27 Cedar Street, New York.

LABORATORY AND CHEMICAL SERVICES

GUARANTEED Reliable Formulas, Trade Secrets, Rare, Dependable Manufacturing Processes for all lines, detailed working directions, "inside" commercial information. Don't buy till I've sent you my valuable literature. Lists. Satisfaction Guaranteed. Dr. Liscomb Miller, Industrial Chemist, Tampa, Florida.

CHEMICAL catalogue for experimenters, 5c. George Ott, 1218 Chestnut, Reading, Penna.

YOUR chemical problem solved and working process furnished for \$5.00. Write me. W. Stedman Richards, Consulting Chemist, Box 2402, Boston, Mass.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

LETTER SPECIALISTS

QUERX Sales Letters Get More Business. Write Him today. Querx, 4418 Michigan Avenue, Chicago.

I WRITE letters, folders, booklets, complete followup for manufacturers, mail order dealers. Long experience. Write for details. L. Taylor, Box 844, Freeport, Ill.

LISTS

NAMES, postcards, cuts. Ben Meyer, 35 West 31st St., New York.

AGENTS names neatly typewritten from our one day old inquiry letters. Price right. D World 166 W. Washington, Chicago.

LITERARY SERVICE

SPEECHES, arguments and orations promptly prepared by experts confidentially. Reasonable rates. University Rhetorical Bureau, 21 Spaulding Bldg., Lowell, Mass.

MAGIC TRICKS

TRICKS, jokes, magical apparatus, sensational escapes. Illustrated catalog, 10c. Oaks Magical Co., Dept. 550, Oshkosh, Wis.

MAGIC tricks. Catalog free. A. Fenner, 2401 Jefferson, Louisville, Ky.

MAIL ORDER BUSINESS

\$50 a week, evenings. I made it. Mail order business; booklet for stamp tells how. Sample and plan 25c. Free, 12 articles worth \$3, Alps Scott, Cohoes, New York.

MANUFACTURING

PATTERNS, wood and metal. Models, tools and dies. Brass, bronze, aluminum and iron casting. Screw machine work, production work of all kinds. Write Modern Machine & Pattern Co., Terre Haute, Ind.

DEVELOPING ideas and manufacturing our specialty. Absolute satisfaction. 33 years' experience; write us. The K. & B. Die & Specialty Co., 2018 Elm St., Cincinnati, Ohio, Dept. C.

ADVICE from engineers will save you from making costly mistakes in buying radio and tool equipment. Write to Popular Science Institute, 246 Fourth Ave., New York City, for list of tested and approved products. See page 6.

MISCELLANEOUS

LEGAL Advice by mail! Reliable, confidential. Satisfaction guaranteed. Information free! Emmons and Emmons, Lawyers, Canton, Ohio.

FORMS to cast Lead Soldiers, Indians, Marines, Trappers, Animals, 151 kinds. Send 10c for Illustrated Catalogue. Henry C. Schlercke, 1034 72nd St., Brooklyn, N. Y.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

MODELS AND MODEL SUPPLIES

WE make working models for inventors and experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

HULIT & CO. General Model Makers, 625 W. Jackson, Chicago. Specializing in high-grade model work on inventions of merit. Our complete equipment insures good work at lowest prices. Try us when you wish something better.

MOTORCYCLES, BICYCLES, SUPPLIES

OVERSTOCKED—200 Used Motorcycles. Must be sold at once. We have Harley-Davidsons, Indians, Hendersons, Excelsiors, Clements. Prices \$25.00 up. Write for our Bargain List. Myerow Brothers, Dept. C, 15 Berkeley St., Boston, Mass.

DON'T buy a bicycle motor attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 4, Galesburg, Kansas.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

NEW and Used Motorcycle and Bicycle Parts. 20% to 80% Discount. Tower Cycle Co., 4305 North Florissant, St. Louis, Mo.

MOTORS, ENGINES AND MACHINERY

MOTORS—New G. E. 1/4 H.P. \$12.50, 1/2 H.P. \$28.50, 1 H.P. \$45. Generators—Radio Transmission 500 V. \$28.50. Battery Chargers—Farm Lighting Generators. All sizes. Lathes—Drill Presses—Air Pumps—other Garage and Shop Equipment. Wholesale prices. New catalog. Motor Specialties Co., Crafton, Penna.

DUNKIN ENGINEERING CO., Patents developed. Models furnished. Special Machinery. Production Engineering, 13000 Superior Ave., Cleveland, Ohio.

CONCRETE Building Block Machines and Molds. Catalogue free. Concrete Manufacturing Co., 307 So. Third St., St. Louis, Mo.

MUSICAL INSTRUMENT

SAXOPHONISTS — Clarinetists — Cornetists — Trombonists — get "Free Pointers." Virtuoso Music School, Buffalo, N. Y.

NOVELTIES

GENUINE Elk Teeth "Cow", mounted \$12. Montana Agate Ringettes \$2. Western Gems \$4 per carat. Western Novelty Agency, Mandan, N. Dak.

"CADDIE"—For wife and sweetheart, swift seller, 75c sample and terms. Autobronze Co., 1527 Fawn St., Phila.

OFFICE DEVICES

ADDRESSING machines, multigraph, duplicators, folders, check writers, sealers, dictating machines, at about half new cost. Pruitt, 117N Market St., Chicago.

OPTICAL GOODS

ARTIFICIAL eyes. Booklet free. Denver Optic, 508 Barclay, Denver, Colorado.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

BUILDERS

TRADE GUIDES

Audels Builders Guides give you practical help in your daily work. They are easy to read and understand, giving complete inside information on the Building Crafts. Each of these sets is a step-by-step

Trade School Course for the apprentice—a trusted Reference for the journeyman and master. Use the coupon below to order the Guides that interest you. Then start easy payments if you are entirely satisfied.

Audels Carpenters and Builders Guides 4 Vols. \$6



"Audels Carpenters Guides are worth four times their price—very handy too as I carry them in my pocket for reference." W. J. Bates, Knoxville, Pa.

Inside Trade Information for Carpenters, Builders, Joiners, Building Mechanics and all Woodworkers. These Guides give you the short-cut instructions that you want—including new methods, ideas, solutions, plans, systems and money saving suggestions. An easy progressive course for the apprentice and student. A practical daily helper and Quick Reference for the master worker. Carpenters everywhere are using these Guides as a Helping Hand to Easier Work, Better Work and Better Pay. To get this assistance for yourself, simply fill in and mail the FREE COUPON below.

Inside Trade Information On:

How to use the steel square
How to file and set saws
How to build furniture
How to use a mitre box
How to use the chalk line
How to use rules and scales
How to make joints
Carpenters arithmetic
Solving mensuration problems

Estimating strength of timbers
How to set girders and sills
How to frame houses and roofs
How to estimate costs
How to build houses, barns, garages, bungalows, etc.
How to read and draw plans
Drawing up specifications
How to excavate

How to use settings 12, 13 and 17 on the steel square
How to build hoists and scaffolds—skylights
How to build stairs
How to put on interior trim
How to hang doors—build stairs
How to lay—lay floors
How to paint



FREE EXAMINATION

\$1 a Month, If Satisfied
1600 PAGES—3700 ILLUSTRATIONS
Flexible Binding—Pocket Size

Audels Masons and Builders Guides 4 Vols. \$6



"Audels Masons Guides are the best books to be had on the subject. Have laid brick for 12 years and am able to judge." H. A. Sonnett, Corliss Sta., Pa.

A new, complete, illustrated trade reference library in four handy volumes. For Bricklayers, Cement Workers, Plasterers, Tile Setters and Stone Masons, including a practical outline of Steel Construction. This new set is a practical Trade Assistant explaining clearly the approved modern methods of masonry construction in all its branches. Easy to understand and apply to every day problems. A reliable and authentic reference work and study-course for the Master Journeyman and the Young Mechanic. Use FREE COUPON below and find out for yourself, without obligation, whether this set will benefit you.

Inside Trade Information On:

Bricklaying, tools, materials
Brick designs, patterns, bonds
Setting frames and foundations
Mortars, scaffolds, estimating
Mortars and mortar mixing
Tile setting, mosaic, hollow tile
Straight edge test, troweling
How to figure brick work
Safe loads, piers, chimneys
Boiler settings, formulas

Arches, anchors, fire stops
Labor and material tables
Concrete, materials, forms
Reinforced concrete. Blocks
How to figure concrete work
Stucco—on old and new bldgs.
Concrete block and tile walls
Plastering—wood lath—metal
Plasterers form of agreement
Plaster materials and tools

Plastering on various surfaces
Stone masonry—materials—tools
Cutting, finishing, estimating
stone
Derricks, bonding, rigging
Steel construction. Structural
shapes
Beams, girders, anchors, fire
proof
How to read blue prints



FREE EXAMINATION

\$1 a Month, If Satisfied
1100 PAGES—2067 ILLUSTRATIONS
Flexible Binding—Pocket Size

Audels Plumbers and Steamfitters Guides 4 Vols. \$6



"Audels Guides are practical, easy to understand and can be relied upon. They cover the entire field in plain language." W. F. Arming, Annapolis, Md.

A new set—just out! A practical, illustrated, Reference Library and Study-Course for Master Plumbers, Journeymen and Apprentice Steamfitters, Gas Fitters and Helpers, Sheet Metal Workers, Draughtsmen, Master Builders, Engineers and all Building Trade Students. This valuable set of handy, pocket-size Guides explains in practical concise language and well-done illustrations all the principles, advances and short cuts of the Plumbing and Heating trade—based on modern practice. Contains careful, detailed instructions on how to figure and estimate various jobs. Use FREE COUPON below to examine, without obligation, this valuable work.

Inside Trade Information On:

Soldering, solders, tinning.
Joint wiping, bending, beating.
Pipe—iron—steel, threading. Mathematics, tables, physics. Materials—iron, steel, copper, brass, lead, tin, antimony, etc.
Sheet metal—galvanized—plate. Sanitation, syphon-

age, tanks. Drainage, sewage, purification. Fixtures—bath—kitchen. Pipe fittings, soil pipe, tools. Laying out work. Roughing. Screwed fittings, flanges, joints. Pipe bending, examples. Elbows. Heating, ventilation, re-

frigeration. Water supply, mains, wells, tanks. Gas fittings. Underwriters. Sheet metal work, problems, methods. Brazing, heating, lead burning. Welding, various welds, methods. Blacksmithing, forges, tools.



FREE EXAMINATION

\$1 a Month, If Satisfied
1670 PAGES—3642 ILLUSTRATIONS
Flexible Binding—Pocket Size

Audels Handy Book of Electricity 1 Vol. \$4

Complete in one handy, flexible, red leather bound volume



1040 Pages
2600 Diagrams



"A treasure of electrical knowledge. The working man's friend." W. B. Corcoran, Ithaca, N. Y.

Audels Handy Book of Practical Electricity is a simplified Ready Reference and Study Course in one pocket size, leather bound volume—for Engineers, Professional Electricians and Students. A reliable authority and handy helper for every electrical worker. Contains important and valuable wiring diagrams, calculations, machine sketches, helps on maintenance and repair. Use this FREE COUPON today and find out, without obligation, how this handy book will help you in your daily work.

Inside Trade Information On:

Electro-Therapeutics, X-Rays, Shocks, Welding, Brazing, Radio Hook-ups, Motion Pictures, Telephone, Telegraph, Cranes, Bells, Elevators, Pumps, Tools, Ship Drive, Railways, Vehicles, Automobile Electric Systems, Ignition, Generation, Lighting, Plant Management, Power Plans, Armature Winding, Repairing, A. C. Motors and Apparatus, D. C. Motors and Apparatus, Alternator Construction, Dynamos, Wiring

Diagrams, Sign Flashers, Cable Splicing, Power Wiring, Outside Airing, Switches, Lightning, Rectifiers, Converters, Transformers, Fuses, Circuit Breakers, Rheostats, Electro Plating, Electrolysis, Storage Batteries, Magnetism, Electrical Energy, Conductors, Insulators, Static, Dynamic, Radio Electricity, Applications. Ready Reference and Index Covering the entire field of Modern Electricity.



THEO. AUDEL & CO.
65 W. 23d St. New York, N. Y.

Please mail me for free examination the books marked (x) below. If I find them satisfactory, I agree to mail \$1 in 7 days, on each set ordered, and to further mail \$1 a month on each set until I have paid the purchase price.

☐ CARPENTERS Guides—4 Vols. \$6

☐ MASONRY Guides—4 Vols. \$6

☐ PLUMBERS Guides—4 Vols. \$6

☐ ELECTRICITY 1 Handy Vol. \$4

NAME.....
ADDRESS.....
OCCUPATION.....
EMPLOYED BY.....

PATENT ATTORNEYS

HERBERT JENNER, patent attorney and mechanical expert, 606 F. Street, Washington, D. C. I report if patent obtainable and exact cost. Send for circular.

INVENTORS—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster and Aliwine, Registered Patent Attorneys in United States and Canada, 232 Ouray Bldg., Washington, D. C.

MONROE MILLER, Ouray Bldg., Washington, D. C. Patent Attorney; Mechanical, Electrical Expert. Free Blue Book gives candid advice.

PATENTS, trade marks, copyrights, Prompt, personal reliable service. Over 30 years' active practice. Write for terms. Book free. Address E. G. Siggers, Box 1, N. U. Building, Washington, D. C.

PATENTS. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 644 G. Street, Washington, D. C.

INVENTORS' Guide free on request; gives valuable information and advice for all who have original ideas or improvements. Frank Lederman, Registered Attorney and Engineer. Woolworth Bldg., 1714, New York.

PATENT Book Free. Charles W. Lovett, Patent Attorney, Lynn, Mass.

UNPATENTED Ideas Can Be Sold. I tell you how and help you make the sale. Free particulars (Copyrighted 1923). Write W. T. Greene, 811 Jenifer Building, Washington, D. C.

PATENTS Procured: Trade Marks Registered.—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Bldg., Washington D. C., or 41-Z Park Row, New York.

PATENTS—Before disclosing an invention the inventor should write for our blank form "Record of Invention." This should be signed, witnessed and returned to us together with model or sketch and description of the invention for free inspection and instructions. Our Three Books mailed free to inventors. Our Illustrated Guide Book, "How to Obtain a Patent," contains full instructions regarding patents. Copies of unsolicited letters from manufacturers and others who are constantly writing us regarding the purchase or leasing of meritorious patents sent upon request. See advertisement on page 161. Victor J. Evans & Co., 937 Ninth, Washington, D. C.

PATENTS—Time counts in applying for patents. Don't risk delay in protecting your ideas. Send sketch or model for instructions or write for FREE book, "How to Obtain a Patent" and "Record of Invention" form. No charge for information on how to proceed. Communications strictly confidential. Prompt, careful, efficient service. Clarence A. O'Brien, Registered Patent Attorney, 184-F Security Bank Building (directly across street from Patent Office), Washington, D. C.

ESTABLISHED 1861. Milo E. Stevens Company, Free Booklet, Patents, Trade-Marks, Copyrights. Offices, Monadnock Block, Chicago; Barrister Building, Washington, D. C.

"INVENTOR'S Adviser", the valuable Patent book with 139 mechanical movements and illustrations, sent free upon request—M. S. Labiner, Patent Attorney, 3 Park Row, New York.

INVENTORS—who derive largest profits know and heed certain simple but vital facts before applying for patents. Our book, Patent-Sense, gives those facts free. Write Lacey & Lacey, 648 F St., Washington, D. C. Established 1869.

MILLIONS spent annually for ideas! Hundreds now wanted! Patent yours and profit! Write today for free book—tells how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. American Industries, Inc., 501 Kresge Bldg., Washington, D. C.

PATENTS FOR SALE

PATENT—Only practical Stop Direction Signal on automobiles. Sale or royalty. F. Cox, 820 Cass St., Chicago.

PHOTOGRAPHY AND SUPPLIES

HAVE you a camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 117 Camera House, Boston, 17, Massachusetts.

ESTABLISH yourself at home, as a photographic expert; make \$75 a week while learning; professional camera furnished free; write quick for full information. International Studios, Dept. 1743, 3601 Michigan Ave., Chicago.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

PRINTING, ENGRAVING AND MULTIGRAPHING

BETTER Printing for Less Money. Write us about your printing needs, and you will save money. Ernest Fantus Company, 525 South Dearborn Street, Chicago.

1,000 BOND Letterheads, envelopes, \$3.25; 500, \$2.25, postpaid. Samples Free. Troib Press, 96 Providence, Worcester, Mass.

100 Business Cards, 50c. Four lines of type. Windermere Press, Box 57, East Cleveland, Ohio.

5,000 2 x 4 Labels \$8.00. Catalog. Wolf Roll Labels, Lawndale, Philadelphia.

DISTINCTIVE Printing! Ask for samples. Franklin Press, B-34, Milford, New Hampshire.

250 BOND Letter Heads (8 1/2 x 11), Envelopes or Cards, \$1.50; 500, \$2.25. G. C. Pfeiffer, Hackensack, N. J.

PRINT your own cards, stationery, circulars, paper, etc. Complete outfits \$8.85; Job Presses \$12, \$35; Rotary \$150. Print for others, big profit. All easy rules sent. Write for catalog presses, type, paper, etc., Press Company, A-3, Meriden, Conn.

HIGH Grade Printing—5,000 20-lb. Hammermill Bond Letter Heads, \$13.75; 10,000, \$24.00. 6 1/2 white wove envelopes, \$2.00 per thousand. The Courier Company, Zanesville, Ohio.

REAL ESTATE—ORCHARDS

PECAN-ORANGE Groves "on the Gulf." \$10 monthly. Guaranteed care. Soon produce \$500.00 yearly. Suburban Orchards, Dept. S., Biloxi, Miss.

THE Real Estate Educator. This book gives a most comprehensive, yet most concise arrangement of useful facts about buying, selling, leasing and sub-letting of Real Estate, contracting, for erection or repairs, mortgaging, transferring, insuring, etc. Cloth, 256 pages. Price \$2.00, postpaid. Popular Science Monthly, 250 Fourth Avenue, New York City.

SALESMEN AND AGENTS WANTED

"SUCCESSFUL" Mail Order Business! Details, 25c! Surety Service, 551 Harvard St., Rochester, N. Y.

AGENTS make \$100 week placing advertising cigar lighters with glass front. Every dealer wants one. Average profit \$25 each. Write for free plan. Drake Mfg. Co., Dept. P., Milwaukee, Wis.

SKAT Sales Agents Wanted. All or Part Time for Skat Hand Soap, Metal Polish, etc. Strictly Commission. The Skat Company, Hartford, Conn.

AGENTS Wanted for Red Dog Tube Patch. Repairs largest blow-outs or punctures without heat or cement. Startling demonstration sells it. 300% profit. If you can't stand "big money" don't answer. Exclusive territory. Samples Free. Auto Products Company, Marion, Indiana.

65c. PROFIT every dollar! Minute demonstration makes sale. Homes, stores, offices, factories, etc. Big repeater. Free sample offer. Mallard Chem. Co., B, St. Louis, Mo.

MANUFACTURE Millerite! You've read about this New Ethyl-Super-Fuel Ingredient for Gasoline. Increases power. Mileage—Saves Gas—Knocks Carbon—Easily made. Your Profit Immense! Stamp brings Valuable Descriptive Formula, Literature of this and Mendit, Fabric Mending Cement, Lightning Electrolyte; Rubber Balloons; Amazon Self-vulcanizing Rubber Repair; Pro-Tex-U, Only Guaranteed Fire Extinguisher; Flynox few drops kills roomful flies; Marcel Permanent Hair Curling Fluid; Denta-perl Tooth Whitener. Latest Pure Food Products; Flavors Beverages; Toilet, Medical; Household; Automobile; Office; Specialties; all lines. You'll be glad you received these lists. Miller, Industrial Chemist, Tampa, Florida.

AGENTS. \$50 = \$200 a week. Genuine gold letters for store windows easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 434-A. N. Clark, Chicago.

GET our plan for monogramming automobiles, trucks, hand luggage and all similar articles by transfer method, experience unnecessary; exceptional profits. Motorists' Accessories Company, Mansfield, Ohio.

\$50 DAILY Selling Salesboards—Make up to \$33 on single sale selling largest, lowest priced line: no samples to carry, write for 3-color catalogue and full particulars. Lincoln Sales Co., Dept. K, 212 N. Sheldon, Chicago.

START profitable business. Silvering mirrors, refinishing auto headlights, tableware, metal plating. Outfit furnished. International Laboratories, Dept. 27 309 Fifth Avenue, New York.

POLMET POLISHING CLOTH cleans all metals. Sells fast at 25c. Sample free. F. C. Gale, 15 Edinboro St., Boston.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

\$10 DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gunmetal Co., Ave. F, Decatur, Illinois.

RUMMAGE Sales make \$50.00 daily. Offer wonderful values. We start you. "Wholesale Distributors," Dept. 34, 609 Division Street, Chicago.

AGENTS—Best seller: Jem Rubber Repair for tires and tubes; supercedes vulcanization at a saving of over 800 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Co., Dept. 467, Amsterdam, N. Y.

EARN \$10 daily silvering mirrors, plating and refinishing metal ware, headlights, chandeliers, bedsteads. Outfits furnished. F. Decie Laboratories, 1133 Broadway, New York.

AGENTS—Write for free samples. Sell Madison "Better-Made" Shirts for large Manufacturer direct to wearer. No capital or experience required. Many earn \$100 weekly and bonus. Madison Mfgs., 511 Broadway, New York.

WE start you without a dollar. Soaps, extracts, perfumes, toilet goods. Experience unnecessary. Carnation Co., Dept. 21, St. Louis.

AGENTS—Clever invention! Inkspoon makes every pen a fountain pen. Fast office seller, big profit, demand increasing everywhere. Exclusive territory offered Sample free. H. Marul Company, Tribune Building, New York.

INSTANT Weld—Repairs large punctures without cement or heat. Lenn's profit one day \$56. Write quick. Free sample. Territory going fast. Tourist's Pride Mfg. Co., Desk R, Minneapolis, Minnesota.

BIG money and fast sales. Every owner buys gold initials for his auto. You charge \$1.50; make \$1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

AGENTS, both sexes, we manufacture and control new household article. Fast seller. Big profits. Exclusive territory. Write now. Connolly, 123 Liberty St., New York.

AGENTS: Sensational Summer Seller. Just out. \$100 a week possible. World Signs, N 166-W Washington, Chicago.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

AGENTS—\$45.00 to \$150.00 per week, selling our Rope Making Machine to make your own Rope with from binding twine, every user of rope needs one of these machines. Fast sellers. Sample machine, \$1.00. Write for particulars. Louis O. Berg Company, Dept SC, Madison, Minn.

AGENTS—\$65 to \$100 a week. High grade all wool suits made to measure, \$25 and \$30. Biggest comm. in advance. Money back guarantee. Free sample outfit. Write A. B. Ferrin, Mgr., Box 1097, Chicago.

WE pay \$48 a week, furnish auto and expenses to introduce our Soap and Washing Powder. Buss-Beach Company, Dept. A48, Chippewa Falls, Wis.

SALESMEN AND AGENTS WANTED

AGENTS Wanted—Something new—Fyr-Fyter sells easily. Makes a spectacular demonstration; car owners, homes, factories, stores, practically buy on sight. Our men make \$10 to \$50 a day. Exclusive territory to producers. If you wish to establish a business of your own with unlimited possibilities for making big money, write us today. Fyr-Fyter Co., 900 Fyr-Fyter Bldg., Dayton, O.

GET our free sample case toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F. St. Louis, Missouri.

AGENTS: Big profits. Best and cheapest window letters made. Easily applied. Dime brings five samples. Particulars free. Stalbrit Company, 1115 Second Avenue, New York.

NEW Camera takes and finishes photos in one minute. Make money selling cameras or taking photos. Exclusive territory. Crown Co., Dept. 958, Norwalk, Conn.

AGENTS Make \$75 to \$100 a week. "Fixit" Rubber Repair seals punctures and blowouts. Sample free. Marquette Rubber Company, 2325L Wolfram St., Chicago.

AGENTS—It's the season's greatest selling hit. Every car owner and garage will buy Auto Mitten Dusters. Costs you 25c., sells for 75c. Free sample. Also Fibre House Brooms, Push Brooms, Scrub Brooms, Dust Mops. National Fibre Broom Co., St. Louis, Mo.

ONLY one sale a day means \$200 per month! Marvelous new adding machine. Retail \$15.00. Work equals \$350 machine. Adds, subtracts, multiplies, divides, automatically. Computes feet and inches. Speedy, accurate, durable, handsome. Five year guarantee. Offices, stores, factories, garages, lumbermen buy one to dozen. A fortune for live agents. Write quick for protected territory and free trial. Lightning Calculator Co., Dept. O, Grand Rapids, Michigan.

AGENTS Everywhere Earn \$150 Weekly. Sell Battery Radium for storage batteries. Millions of batteries in need for it. Sensational Opportunity. Great repeater. No room to tell story here. Write quick. G. J. Age & Company, Muscatine, Iowa.

WONDERFUL invention eliminates needles for phonographs. Preserves records. Abolishes scratching. Day's supply in pocket. \$20 daily. Sample on approval if requested. Everplay, Desk S-10, McClurg Bldg., Chicago.

NEW Wonderful Seller. Cost 10c., profit \$1.40. Monogramming Autos. Experience unnecessary. Free samples. Worcester Monograms, B 126, Worcester, Mass.

ROBT. H. INGERSOLL of \$1 Watch Fame wants good men to sell his Dollar Stropping outfit, an ingenious invention for sharpening all makes of safety razor blades. Great Economic value. Meeting with nationwide approval. Easy to sell. Big repeat business. Agents having remarkable success. Full particulars. Robert H. Ingersoll, 476D Broadway, New York City.

MEN Everywhere—operate your own profitable business. No competition. No capital. Just few weeks training by mail. Croskey, Dept. 1995H, Richmond, Calif.

300% PROFIT Selling Mitchell's Magic Marvel Washing Compound. Men and women clearing hundreds weekly. Wonderful seller. Big repeater. Nature's mightiest cleanser. Free sample. L. Mitchell, Drawer 1308, E. 61st Street, Chicago.

"SHINE-O", The Wonder Cloth, Cleans and Polishes all metals. Write for samples and full particulars. Shine-O, 519 Ashbury, Evanston, Ill., Dept. 4.

AGENTS—big seller—\$20 a day easy selling Taylor caps—made-to-measure—every man buys—some want two or three caps. Samples free and cap free to good agents. Write quick for fast money making proposition. Address, Taylor Cap Manufacturers, Dept. 9-R, Cincinnati, Ohio.

DISTRICT salesman for union made, hand tailored, all wool suits and overcoats at \$23.50. Prefer married man with sales experience. \$35.00 weekly to start. Apply D. N. Harvey, Box 00, Chicago.

NOTHING like this: Sample \$3.00, retails \$15.00; write, Miracle Laboratories, Fellows, Calif.

WASH Clothes the new way. Use the Torrent Automatic Washer. You will be delighted. Special offer to one in each locality. Storm Royalty Co., 3614 Enright Ave., St. Louis, Mo.

WANTED—Representatives in every factory in the United States, Popular Science Monthly, 250 Fourth Ave., New York.

EMBOSSED display signs mean big money, and independence for you. Sell every merchant making 250% profit. This proposition is different. Write and see why. Artistic Sign Works, 799 Broadway, New York.

BIG money—fast sales; everyone buys gold initials for their auto; sell \$1.50, profit \$1.44. Ten orders daily easy. Samples, information free. World Monogram Dept. 28, Newark, N. J.

SELL books and formulas by mail; money making circulars at one-fourth cost. Big profits. Particulars free. Ellico, 523 So. Dearborn, Chicago.

DISTRICT salesman: experienced man to introduce our line of finest all wool suits and overcoats at \$23.50 to the men of your town. This is an exceptional opportunity for the right man. If you're reliable and responsible and can furnish satisfactory references, let us hear from you at once. Address Dept. 609, William C. Bartlett, Inc., 850 W. Adams St., Chicago.

200% PROFIT. Fast selling automobile necessities. Endorsed by auto clubs and engineers. Taylor Products Co., 22 West Naghten St., Columbus, Ohio.

OIL or coal? "The Burning Question," interesting booklet, discusses high efficiency low priced residence oil burners. Copy free. Write E. L. Miller, Manufacturer Climax Burners, 34 Climax Bldg., Kansas City, Mo.

WANTED—agents to sell hand made Candlewick Bed Spreads, one dollar commission each sale. Good proposition. P. O. Box 110, Dalton, Ga.

A BUSINESS of your own. Make and sell chipped glass name and house number plates, checkerboards, signs. Booklet FREE. E. Palmer, Dept. 513, Wooster, Ohio.

\$100 WEEKLY. Pleasant work; appointing local agents to introduce Mother Hubbard Foods, no canvassing, no delivering, no money invested. Adam Inthout, 550 Congress, Chicago.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

AGENTS—amazing new fluid mends rips, tears, holes, in one minute without sewing. Won't pull, boil, wash or tear off. Sells to every woman for 50c. Your profit 100%. \$25.00 a day easy. Send 50c for sample tube to Nu-Way Co., Dept. M-110, Mt. Healthy, Ohio.



Applied Electricity—8 Big Volumes

Read this NO MONEY offer

HERE is an amazing offer—an offer that will astonish you by its liberality and the opportunity it gives you to prove to yourself its value—without your having to pay a single penny.

We want every earnest man, every one who has a spark of ambition in his make-up, to see these 8 big wonder books on electricity and to know how he can be helped to bigger pay, bigger earnings and a larger place in life by having all these facts at his finger tips.

This is the sole reason for making our startling offer—an offer which, as never before, brings these 8 big books within the reach of everybody.

We Ship FREE

Yes, it's true; simply send us the coupon with your name and address plainly written and we will ship ALL the books promptly, with no obligation whatever except your promise to look them over carefully and read what you have time for. Keep them for ten full days, satisfy yourself of their wonderful value before you decide whether or not you want to keep them. After you have seen their tremendous value and have noted how clearly and simply everything is explained, you can send us only \$2.00 and then only \$3.00 a month until the special low price of \$29.80 is paid. There is nothing further to pay us, no membership fee, no special charges to us of any kind.



Storage Battery Construction. An example of the careful attention to detail in all illustrations.

Most Complete Electrical Books We Ever Published

We give you our word for it that we have never written or printed a more complete set of books on electricity; thousands of facts are clearly stated and hundreds of subjects are fully covered.

Electric
Lighting
Storage
Batteries
Wiring
Radio

Power Stations
Signal Systems
Electric
Railways
Switchboards

Magnets
Coils
Controllers
Motors
Dynamos

The above are only examples of the completeness and thoroughness of these modern books. Even Electrical Engineers find them of great value.

Everything you need to know about Electricity in these 8 big books

American Technical Society Membership

This is a great organization for the dissemination of special knowledge—we have over a million dollars of resources, all of which are back of this offer which includes, if you take advantage of it now—

Free Consultation Membership

Twenty experts are ready to answer your questions and help you to qualify for a *Better Job or Bigger Pay* where you are.

Have you ever had such an opportunity before—did you ever hear of so liberal an offer?



Small reproduction of full page illustration of Electrical Laboratory Bureau of Standards, Washington, D. C.

Don't Hesitate

WRITE NOW. There are no strings to this offer at all; it is an honest plan offered to honest, ambitious men, to help them help themselves. Remember that one fact alone in these books, and having it at your finger tips, may mean hundreds of dollars to you. This is not an exaggeration, but a plain statement of fact.

Send for your books NOW. You may never have another opportunity. You may never see this offer again.

For Free Offer Use Coupon

FREE SHIPMENT COUPON

AMERICAN TECHNICAL SOCIETY,
Special Dept. E-720, Chicago, Ill.

I would like to look at the 8 books described above. You may send them to me on your Great Offer. I will examine them carefully and return them in ten days—or if I like them I will send \$2.00 then and \$3.00 per month until the low price of only \$29.80 is paid.

You are to include FREE CONSULTING MEMBERSHIP in the American Technical Society.

Name.....

Street.....

City.....State.....

Employed by.....



Is your mind still traveling behind a danger flag?

In 1896 the automobile was bound to become a tremendous factor in modern life. Scientists knew it; engineers knew it; a few business men knew it and became millionaires. Still it was generally looked upon as a nuisance, a menace to life and limb. *There was a law in England that every car must be preceded by a red flag!*

The history of all scientific progress is like that. A few have vision and profit by it; most minds travel slowly behind a red flag.

What do the inventions of the last twenty years mean in your life and your children's? What chances do they offer for profit to you? How will they affect your business? What changes can you make in your plans to turn them to your advantage?

All these questions, and hundreds of others, are answered in The Popular Science Library—16 volumes, profusely illustrated, each book by an authority in his subject. Here, in everyday language, is a wonderful picture of this new world of ours.



The interesting booklet, "The Wonderland We Live In," sent free to readers of POPULAR SCIENCE MONTHLY, tells all about this remarkable Science Library which can be yours at a surprisingly low cost. Send the coupon today, and receive it by return mail.

The Popular Science Library

At last the whole story of modern science and invention in sixteen handy volumes, edited by Garrett P. Serviss



P. F. Collier & Son Co.
250 Park Ave., N. Y. C.

Without placing me under any obligation whatever, please send me the free descriptive booklet giving full particulars of your new Popular Science Library, and advise how I may secure the books by small monthly payments.

Name _____
Mr. _____
Mrs. _____
Miss _____
Address _____

(The publishers cannot undertake to send the booklet free to children)

3452-PSD-L

SALESMEN AND AGENTS WANTED

SELLS at sight. Improved models, print merchant's ad on wrapping paper, boxes, bags, etc. Good commission. Send 10c for postage and sample work. Automatic Ad-Stamp, Joplin, Mo.

FREE sample—"Rain Shield Wiper", retails \$1.00—cost 25c. Just invented. No cloth—no paste—no attachment. Sold clear and rainy days—(1) Rub keeps windshield clear 24 hours. Automobiles buy quickly. Riley made \$198—three days. Experience unnecessary. Wonderful sideline. NuLife Corporation, Hartford, Conn.

AGENTS—Steady income. Large manufacturer of handkerchiefs and dress goods, etc., wishes representative in each locality. Factory to consumer. Big profits, honest goods. Credit given. Send for particulars. Freeport Mfg. Co., 24 Main St., Brooklyn, N. Y.

AGENTS, \$11.80 daily in advance (send for sworn proof) introducing new insured bosiers. 57 styles, 40 colors, guaranteed seven months. Fall and winter line now ready. No capital or experience required. You simply take orders. We deliver and collect (or you can deliver, suit yourself). Credit given. Pay You Daily, monthly bonus besides. We furnish samples. Spare time will do. M. Cochec Textile Co., Station 15210, Cincinnati, Ohio.

GENERAL Distributors, agents, salesmen, wanted for quick-selling automobile specialty: can average \$75.00 to \$100.00 weekly, selling direct, to the trade, through sub-agents; lifetime opportunity for men looking for A No. 1 sales proposition; permanent business that yields results right from the start. Free folder explains. Atkinson Co., Mrs. Cynthia, Ky.

GREATEST temper saving device! Takes slack and kinks from telephone and electric iron cords. \$25 daily. Samples on approval if requested. Neverknot, Dept. 19, McClurg Bldg., Chicago.

SELL greatest kitchen labor saver. Hydro motor mixer for cream, mayonnaise, batter. 100% profit. Send \$3.00 for mixer, details. Hydro, 449 Bryant, San Francisco.

AMBITIOUS men, honest, earnest and willing to work. We have proposition unequalled in selling field. Line of men's clothes, tailored to special order, finest quality Virgin Wool fabrics, all at one low price of \$31.50. Positively equal to \$50.00 values. We supply powerful sales outfit, give complete co-operation, pay liberal commissions and cash bonus and give protected territory to producers. Experience desirable but not necessary. What we want is sturdy, dependable men ambitious to make good. If you are such a man, let us hear from you at once. Address Dept. 822, Goodwear Chicago, Inc., 844 W. Adams St., Chicago.

\$25.00 HUNDRED made selling clippings on successful mail order plan. Particulars FREE. Pruitt Publishing Co., 2750-S, Lister, Kansas City, Mo.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

WHY work for others? Make and sell your own goods. We show you how. Free book explains everything. National Scientific Laboratories, 1908-A Broad, Richmond, Va.

SELL shirts and overalls direct to wearer. Big profits. Work full or spare time. No experience required. Big variety dress shirts with splendid line Union-made work and flannel shirts, overalls, coveralls, work pants, leather and sheep lined coats. Write to-day for free selling outfit. The Nimrod Shirt Co., Dept. 25, 4922 Lincoln Avenue, Chicago.

WORLD'S largest neckwear manufacturer wants salesmen, sell direct. Remarkable opportunity. Commissions 32½%. Complete line. Greatest values. Write Beacon, 1021 Beacon Bldg., Boston, Mass.

ENVELOPE sealer selling \$4.50 seals 3500 envelopes hour! Tremendous Demand. Exclusive territory. Big repeats. Write today. Free particulars. Red-E, 2013 Nottingham Bldg., Boston.

FREE sample outfit. \$13.50 suits. \$3.00 profit. Whirlwind seller. Write Chicago Super-Built Garment Co., Box 453, Chicago.

10,000 selected manufacturing formulas. Money makers. Southern Trading Co., 53, Flushing, N. Y.

MY "Photo Art Rings" sell big. Sample and proposition 50c. Russell Johnson, Clarkfield, Minn.

SELL high grade stationery. Particulars free. W. F. Messenger, Dept. P., Stillwater, N. Y.

SALESMEN—four square suits reduced to \$9.99. Same deposit. Four patterns. Guaranteed two years. Write quick for free outfit. Stone-Field, KL-2554 Wabash, Chicago.

SUCCEED with your own products—make them yourself. Formulas, processes by experts. Trade secrets. Modern master methods. Catalog free. C. Thaxly Co., Washington, D. C.

AUTOMOTIVE specialty salesmen. Year round steady profits. Adams-Barrs, Columbus, Ohio.

QUALITY shoes—factory to consumer at popular prices. Your cash profits \$1.00 to \$2.00 pair. Gre test up to date line in America, let us prove it. Repeat orders guarantee steady income. The Long Wear Shoe Company, Dept. FE, Minneapolis, Minn.

NEW specialty costs 16c. Sells for 50c. Retail \$1.00 value. 30 other big profit sellers. Agent's outfit free. Write quick. General Products Co., Dept. 54-N, Newark, N. J.

SALESMAN, if you think in terms of \$5,000 the first year write us personally. Strong line for retail stores. Nationally advertised. Established concern has unusual opportunity. Liberal weekly advance to producer. Continental Co., 1922 Euclid Ave., Cleveland, Ohio Dept. PS.

SALESMEN, newly invented, fast selling, slug-proof ball gum vendor, \$10 commission one sale. Investment salesmen can make \$1,000 monthly selling operators. Specify full or part time. Peerless Products Company, New York Life Building, Kansas City.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

SALESMEN AND AGENTS WANTED

MAKE \$100 weekly in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays \$100 profit. No big investment, no canvassing. Sharpe of Colorado made \$955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. Ozarka, Inc., 126 West Austin Ave., C. Chicago.

LIVE wire salesmen to join our prosperous sales force. Earn \$75 to \$125 weekly from the start—selling the biggest and fastest selling tailoring line. Set your own profit on each sale. 300 all-wool fabrics retailing from \$22.50 to \$45.00. Satisfaction guarantee. Experience helpful but not necessary—we teach you. Write for big line today. Ambitious men can become District Managers. Address Sales Manager, M. A. Wells, Box 483, Chicago, Illinois.

TAKE orders for coffee, sugar, flour, meats, canned goods, staple groceries, also paints, radio sets, tires, auto and tractor oils. No capital or bond required. We deliver and collect. Permanent business. Big pay. Write at once. Hitchcock-Hill Co., Dept. 81, Chicago.

NO dull times selling food, people must eat. Federal distributors make big money, \$3,000 yearly and up. No capital or experience needed, guaranteed sales, unsold goods may be returned. Handsome \$15.00 sample case sent on trust. Free samples to customers, repeat orders sure. Exclusive territory. Ask now! Federal Pure Food Co., L-2311, Archer, Chicago.

SELL the oversized Johnson \$7.00 Red Pen direct to users at \$3.50. The cream of the selling season is here. Send for agents' sample at \$1.75 and full details, or send for details only. Johnson Pen Co., Dept. C, 117 S. First St., Rockford, Ill.

ARE you old at forty? See our advertisement on page 143 of this issue. The Electro Thermal Company, 4050 Main St., Steubenville, Ohio.

STAMMERING

ST-TUT-T-T-TERING and stammering cured at home. Instructive booklet free. Walter McDonnell, 59 Arcade, 1126 Granville Avenue, Chicago, Ill.

STAMPS AND COINS

NEWFOUNDLAND Caribou 4 and 5 cents, catalog 30 cents, packet of over 50 different stamps, catalog \$1.07, scale perforation gauge, ruler, price lists, all for 9 cents to introduce approvals. Fennell Stamp Co., Dept. C, St. Louis, Mo.

25 PRECANCELS—and copy—"Badger's Precancel Partner" 4c to Approval Applicants. "Badger," Brookville, Florida.

STAMPS, 100. All different, 3 cents. Lists free. P. S. Quaker Stamp Co., Toledo, Ohio.

1,000 DIFFERENT stamps \$1.00. Fred Onken, 630 79th Street, Brooklyn, N. Y.

100 DIFFERENT stamps free to popular approval applicants; postage 2c. Christensen, 124 Second Street, Milwaukee, Wisconsin.

1000 DIFFERENT stamps, wonderful quality, \$1.00. C. E. Nickles, 3002 Rodman St., Washington, D. C.

OLD Coins. Large Spring Selling catalogue of coins for sale free. Catalogue quoting prices paid for coins, ten cents. William Henslein, 1018 Tremont Street, Boston, Mass.

CALIFORNIA gold ¾ size, 27c.; ¾ size, 53c. White cent and catalogue, 10c. Norman Schultz, Colorado Springs, Colorado.

\$5.00 FOR 10c.—200 all different (mostly unused) from Ireland, Newfoundland, Jamaica pictorial, etc., triangle set, airplane set, small album and bargain lists—all for 10c to new approval applicants. Victoria Stamp Co., London, Canada.

STAMPS, 105 China, etc., 2c. Album (500 illustrations) 3c. Bullard, St. Louis, Mo.

OLD Foreign Coin set Free. Cornish Company, Schenectady, N. Y.

UNITED STATES and Foreign money. Medals. Catalogue and Villa Bill, 10c. Alexis Mengelle, Colorado Springs, Colorado.

OVER 100 different stamps from Iceland, Congo, Nyassa, Mozambique, Cochiti, etc., perforation gauge, scale, set list, etc., all for 10c only, to applicants for our fine approvals. Payn Stamp Co., 945 Vista Drive, Los Angeles, Calif.

STAMPS—50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., 10c. 50 different U. S. 25c. 1,000 hinges, 10c. 1,000 mixed, 40c. List free. C. Stegman, 5949 Cote Brillante, St. Louis, Missouri.

TECHNICAL SCHOOLS

CHICAGO Technical College offers short, intensely practical courses in Drafting and Engineering—civil, mechanical, electrical, structural—Architecture, Building Construction, Plan Reading, etc. Courses fitted to your needs. No time wasted. Instructors are experts. Graduates in demand at big salaries. Opportunities for part-time work while studying. Day and evening classes. 22nd year. Enter any time. No special preliminary training required. Low tuition—easy terms. Write for 52-page illustrated Blue Book, describing opportunities open to our graduates. Chicago Technical College, 23 Chicago Tech. Building, Chicago.

TYPEWRITERS AND SUPPLIES

TYPEWRITERS; all makes; lowest prices; 5 year guarantee; \$1.00 month rental proposition; send for illustrated catalogue. Henry Typewriter Co., 217 West 125 Street, New York, N. Y.

TYPEWRITERS all makes. Save one-half. Thoroughly rebuilt in our factory by the famous "Young Process." Fully guaranteed. Free trial. We handle all standard makes. Cash or sold on easy terms. Write for Catalog. Young Typewriter Co., Dept. 576-A, Chicago, Ill.

UNDERWOOD Typewriters—only \$3.00 down. Easy monthly payments. Low prices at less than manufacturers. 10 days' free trial. Rebuilt, all worn parts replaced. Just like a new machine. 5-year guarantee. Write for big free catalogue, 3707. Shipman-Ward Mfg. Co., 3707 Shipman Bldg., Chicago, Ill.

WANTED

DETECTIVES needed everywhere. Experience unnecessary. Particulars free. Write, George Wagner, former Government Detective, 1968P Broadway, N. Y.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

He Poked His Fingers in a Lion's Mouth

(Continued from page 35)

was far harder. The beast weighed $1\frac{1}{2}$ tons and had such big feet and was built so close to the ground that it was hard to cast it. Ten men hobbled Mr. Rhino, tugged and tugged, and couldn't budge him. Finally, some one got the brilliant idea of building a hill with bags of grass and slowly heaving him over on it. Some job! But it was done, and after two operations the animal was able to see again.

Camels are a little easier to throw. This is necessary when something happens to their feet, as often does.

MOST of the troubles Doctor Blair has to contend with are digestive. Lions, camels, monkeys, bears, antelopes, birds, snakes, all suffer from digestive troubles. Castor oil and cod liver oil, of which the Zoo uses gallons and gallons, are in constant use. And it cures most of the digestive ills. But it doesn't cure the snakes. Snakes, when they are ill, refuse to feed and have to be artificially stuffed, which is quite a job. One snake, whose stomach was $5\frac{1}{2}$ feet from its mouth, had to have rabbits, guinea-pigs, and chickens stuffed down his throat once every four weeks for a year.

Pneumonia gives the Zoo doctors much concern. Monkeys particularly suffer from pneumonia, for they are extremely sensitive to change in climate. Bronchitis, mumps, and other familiar diseases are common troubles with monkeys. And yet these all respond to treatment. Fresh air and inhalations of medicated vapors bring a ready cure.

As a matter of fact, much of Doctor Blair's work is preventive medicine. Anything that is likely to cause trouble is carefully avoided. Diets constantly are being experimented with. All the animals are studied and watched carefully.

Constant study has been absolutely necessary, for when Doctor Blair came to the Bronx Zoo, he had to form his own department. He was called there from McGill University in Toronto, where he was a student of the class of 1902 in comparative and veterinary medicine, to organize and develop the New York Zoological Society's medical department. That was 24 years ago.

DOCTOR BLAIR'S staff is small, but so well trained that every morning he gets reports that tell him the exact condition of every animal in the park. The three curators of the Zoo—Dr. William T. Hornaday, who designed the park, opened it November 9, 1899, and has been its only director, in charge of 565 mammals; Dr. Lee S. Crandall, in charge of 2474 birds; and Dr. R. L. Ditmars, in charge of 550 reptiles—report every symptom to the Medical Department.

Doctor Blair immediately investigates all cases that seem to require his attention. If necessary, the sick animal is removed to the hospital, the best equipped of its kind, with a surgical ward, a medical ward, an operating room, a hoofed-animal ward, a diet kitchen, and a morgue, all conveniently arranged.

From \$22.00 a Week Clerk to \$85.00 Radio Expert

How a young man discovered his opportunity in a fascinating new field, and quickly prepared himself in his spare time for the position he wanted. As related by himself.

I WAS interested in radio from the very beginning. I bought a little one-tube set when radio first became popular and I experimented with it, bringing in snatches of song from the air and trying to get distant stations. But my set was very much of a mystery to me. Like most people, I knew how to use it, how to tune in on local stations, but I did not understand how it worked. I often wondered.

"At that time I was working as a clerk in a large mail order house. I took the position because I thought it would be a stepping-stone and that I would quickly advance to something bigger. But years went by and I was still a clerk. Somehow I had fallen into a rut, and there I remained. I used to get terribly discouraged at times, and I wondered what my future would be. Would I never be anything more than just a clerk?"

"I drifted on, and nothing ever happened. I got an occasional increase in salary, but that was all. I was becoming resigned, was losing whatever shred of ambition I had left. My salary reached \$22.00 a week, and there it remained. I knew I could never earn more in that kind of work. But what could I do? For what was I suited?"

A New Industry

"Then came the big radio boom, and everybody began talking about the wonderful new industry. Half the people in our town bought receiving sets. On the trains I heard nothing but radio gossip, and the newspapers were crowded with news on radio development. I had a sudden idea—an inspiration.

"Here was an industry that was still an infant compared to other industries. It was young and fast-growing, and evidently would some day be one of the greatest industries in the world. Surely in so new and important an industry there must be big opportunities for beginners—a rare chance for quick success and rich rewards. I would get into the field at once, start at the bottom and grow up with it! I would get out of the rut into which I had fallen, into a new field ripe with opportunities.

"But how? I had to depend too much upon my \$22.00 a week to give it up. If only I could study radio at home in my spare time, and prepare myself for a radio job without giving up my regular work. I decided to make inquiries, and discovered that just such a course was offered by the National Radio Institute of Washington, D. C. I enrolled for their famous correspondence course, keeping it a secret from everyone at home.

"For several months I studied at home, in the evenings and whenever I could spare a half-hour or so. The time passed quickly because it was so fascinating. In a few months I had mastered what I had believed 'the mysteries' of radio, and was qualified to take a position in charge of a radio department in a large wholesale house.



"How surprised everyone was when I announced calmly—and I'll admit a little proudly!—that I had graduated from the National Radio Institute

and that I had my certificate as a radio-trician. They were even more surprised when I told them that the Institute had found a position for me right in my own town at \$50.00 a week! They all wanted to know how I did it—and some of the fellows were mighty jealous.

I Earn Big Money

"Advancement came quickly, and now I am a radio engineer earning \$85.00 a week. Very often I earn extra money in my spare time helping people put up their sets. I expect another promotion soon and it will not be long before I am earning \$100.00 a week. Radio is constantly progressing, there are new improvements all the time, and those who are in the field naturally develop as radio develops. I am glad I got in early.

"I am glad to write this story for publication because the National Radio Institute alone has made my success possible. It offers an absolutely complete course which qualifies you for the Government first-class license and for the big-pay jobs in radio. I would advise anyone who is interested in radio as a profession to use this coupon and send at once for the valuable information that is offered free. Don't hesitate to use it—there is no obligation. I, too, sent off for the free information before enrolling. Why don't you do it—now?"

Special Offer

"A special reduced rate is being offered to those who mail the coupon AT ONCE. Get in on the ground floor and save money. Just address the National Radio Institute, Dept. 12 MB, Washington, D. C."

National Radio Institute Dept. 12 MB, Washington, D. C.

I am interested in radio as a profession. You may send me, free and without obligation, your interesting little book, "Rich Rewards in Radio," telling about the future of radio, and all information about your spare-time, home-study plan and your free employment service.

Name..... Age.....

Address.....

City..... State.....

WANTED

Men to manufacture Metal Toys and Novelties. Good chance to start your own well-paying business producing such big sellers as Toys, Novelties, Ash Trays, Book-blocks, Souvenirs, Advertising Specialties, Paper Weights, etc. We furnish forms with complete outfit for speedy production. Absolutely no experience or tools necessary; no special place needed. Small investment puts you on road to success. Demand exceeds supply and we assist and co-operate with our manufacturers in selling their products. We put you in touch with the buyers and assure an outlet for your goods. Strictly a business proposition and thorough investigation invited. A splendid opportunity for an enormous and profitable business for ambitious men. No others need apply. Catalog and information mailed on request.

Metal Cast Products Co., 1696 Boston Road, New York



New Kind of Belt Reduces Waist—Easily!

Look slim at once Say "good-by" to bulging waistline. Amazing new belt literally melts fat away. Produces same result as expert masseur.

Off with that bulging waistline. Melt fat away. At last you can do it safely, easily, comfortably—and without great expense. Not by starvation diets or harmful drugs. There is only one correct way to take fat away—that is

A Self-Massaging Belt That Is Always on the Job

Massage—Science proves—is the only safe, correct way of removing weight. But Masseurs charge big fees—they are effective only for a half hour or so occasionally.

The remarkable Well Reducing Belt is always on the job. Every second you wear it, it works for you. Massaging fat away with every move you make, 4 to 6 inches reduction in a few weeks is quite usual.

As it reduces fat, it builds up healthy, firm muscles. It supports the stomach walls, improving digestion, gives better carriage. You feel years younger.

The Well Health Belt is made of the same kind of scientifically treated rubber that is used by professional athletes and jockeys. Endorsed by physicians. Write for description and special 10-Day trial offer. The Well Co., 1010 Hill St., New Haven, Conn.



The Well Company, 1010 Hill St., New Haven, Conn.

Gentlemen: Please send me, without obligation, complete description of the Well Scientific Reducing Belt and also your Special 10-Day Trial Offer.

Name.....

Address.....

City.....State.....



Steady Work—No Layoffs—Paid Vacations
Travel—See Your Country
Common Education Sufficient
Many Other U. S. Gov't Jobs Now Obtainable

ART

We Teach COMMERCIAL ART

Meyer Both Company,
maintaining the most
widely known Commercial
Art Studios in the World,
offers you a practical training based
upon 25 years' success in producing
over a quarter million commercial
drawings for leading advertisers.

Many of the full page illustrations appearing
in leading national magazines are drawn
by Meyer Both Trained Artists.

Our graduates are filling attractive positions
in every section of the country. Home study
instruction.

GET FACTS BEFORE YOU ENROLL IN ANY SCHOOL

Ask the advertising manager of the
leading newspaper in your locality about
us. Send 4c in stamps for illustrated
book telling of the success of our
students, and the unusual opportunity
for both men and women in
this attractive profession.

MEYER BOTH COMPANY

Dept. 35
Michigan Ave. at 20th St.
CHICAGO, ILL.

NOTE—To Art and Engraving
Firms: Secure practical
artists among
our graduates.
Write us.

How to Pick a New Boss

(Continued from page 32)

whom he can turn for such information. The value of tapping every available source of information about a job was remarkably demonstrated recently by a successful advertising manager who was drafted for an important executive position with a publishing house. At eight o'clock in the morning a total stranger telephoned to his home, with the request that he meet the stranger in his office at 10, to discuss a possible connection. Immediately the advertising man called up a number of his friends, asking facts about the concern and its owner. Two hours later he went to keep the appointment, having clearly in mind the past history and policy of the publishing house, as well as the record and reputation of the man he was to meet. As a result he was able to make a prompt decision, with a clear understanding of the conditions he would meet in making the change.

OF COURSE, most of us are not so fortunate in tapping reliable sources of information, yet often we fail to get the facts simply because we fail to try. The use of scientific methods is not the sole privilege of employers. More and more men who are seeking to better themselves are applying some of the same methods. Instead of doing all the answering of application queries, they are learning to put some pointed queries themselves. They are putting the boss on the carpet. They are picking studiously and carefully the man and the firm to which they may give the best possible service and as a result have the greatest chances for success.

Recent Publications

Biology, by Vernon Kellogg. How to study biology for yourself, with a list of some of the best books about it. American Library Association.

Man's Life On Earth, by Samuel Christian Schmucker. A vivid, interesting story about what is known today concerning men who lived before recorded history. Illustrated. The Macmillan Company.

The Wonder Book of Plant Life, by J. H. Fabre, translated by Bernard Miall. A skilled observer of nature shares his knowledge of the marvels of plant growth. Illustrated. J. B. Lippincott Company.

Plants and Man, by F. Bower. Interesting essays on every-day botany. Illustrated. The Macmillan Company.

High Lights of Geography—North America, by David Starr Jordan and Katherine Dunlap Cather. A new kind of geographical reader for children that gives fascinating legends and stories of geology not found in the ordinary textbook. Illustrated. World Book Company.

Automobile Starting, Lighting, and Ignition Systems, by Victor W. Page. A comprehensive explanation of electrical systems for motorists, students, mechanics, and repair men. Revised. Contains 325 wiring diagrams. Illustrated. Norman W. Henley Publishing Company.



Electricity at your finger ends

Know the facts in Electricity. They mean more money and better position for you. Hawkins Guides tell you all you need to know about Electricity.

Every important electrical subject covered so you can understand it. Easy to study and apply. A complete, practical working course, in 10 volumes.

Books are pocket size; flexible covers. Order a set to-day to look over.

HAWKINS GUIDES

3500 PAGES \$1 A VOLUME
4700 PAGES \$1 A MONTH

These books tell you all about —

Magnetism — Induction — Experiments — Dynamos — Electric Machinery — Motors — Armatures — Armature Windings — Installing of Dynamos — Electrical Instrument Testing — Practical Management of Dynamos and Motors — Distribution Systems — Wiring — Wiring Diagrams — Sign Flashers — Storage Batteries — Principles of Alternating Currents and Alternators — Alternating Current Motors — Transformers — Converters — Rectifiers — Alternating Current Systems — Circuit Breakers — Measuring Instruments — Switch Boards — Wiring — Power Stations — Installing — Telephone — Telegraph — Wireless — Bells — Lighting — Railways. Also many Modern Practical Applications of Electricity and Ready Reference Index.

SHIPPED TO YOU FREE

Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Send Coupon now — today — and get this great help library and see if it is not worth \$100 to you — pay \$1.00 a month for ten months or return it.

SEND NO MONEY

THEO. AUDEL & CO.
65 W. 23rd St., N.Y.

Please submit for examination
Hawkins Electrical Guides
(Price \$1 each). Ship at once, pre-
paid, the 10 numbers. If satisfactory, I
agree to send you \$1 within seven days and
to further mail you \$1 each month until paid.

Signature _____
Occupation _____
Employed by _____
Residence _____
Reference _____ 10T-34

Auto Men Wanted!

Big Pay
jobs now open in California and everywhere for trained Auto mechanics, ignition and battery experts, garage managers, etc. We will train you, quickly and easily in our big Million Dollar School of Shops. No previous experience or education needed. Expert instructors. Short, practical courses. Low tuition rates. You can earn board and room expenses while learning. 15,000 successful graduates assure your success.

FREE AUTO BOOK
Big illustrated book tells you about this famous school and how we help you get big pay jobs.
Write—Dept. 752

NATIONAL
Automotive & Electrical School
Los Angeles, California

What Could You Do With \$50—?

See the Cash Prize Offer on Page 4.

A SERVICE FOR YOU

In Buying Radio & Tool Equipment
For list of tested and approved products write to the Popular Science Institute of Standards. See Page 6.

Here Are Correct Answers to Questions on Page 57

1. It is due to colored pigments that are a part of the movable curtain in front of the eye, the curtain that regulates the amount of light that enters the eye.

2. The heat increases the vibration of the atoms, or perhaps of the electrons inside the atoms, so much that they finally begin to start waves in the ether.

3. The pane has two surfaces; its inside surface and its outside one. One of the two images is reflected from the inner surface; the other image from the outer one.

4. If a deep bed of sand on the sea-shore or in a river bed is saturated completely with water and especially if there is a spring of water seeping upward through it, the sand is apt to be loose, so that a person getting into it will sink. This is a quicksand, but it is a far less common thing in fact than it is in novels.

5. Remember that what happens when you charge the battery is that a chemical accumulates on one of the plates. If you tried to use an alternating current a little of this chemical would be formed first on one plate and then on the other. While one lot was forming the other lot would decompose.

6. No. The appearance of rays or beams of sunlight is caused by fine dust in the air, just as a ray of sunlight entering a dark room will light up dust motes in the air so that you can see the path of the beam.

7. Space transmits the ether waves of radiant heat, it does not absorb them. Only things that absorb the rays are warmed by them. Our hand absorbs them and that is why sunshine feels warm to it.

8. They are clouds of gas, perhaps with some solid fragments, that come into the solar system from outer space.

9. Not any serious damage. If we hit the head of the comet and there happened to be some fairly large solid lumps in it there might be a little damage from falling stars.

10. This is a form of hypnotism, you yourself being both hypnotist and subject. Suppose you are climbing down a ladder out of a burning building. Your attention is fixed completely on the fire and on the progress you are making in your escape. You have no brain power left to notice anything else at all.

11. It was cut down, during millions of years, by the Colorado River that still flows in the bottom of it.

12. Because the driftwood has taken up a lot of mineral elements from the sea water. When these mineral elements in the wood get into a fire they color it different colors, just as the salt colors it yellow or as red-fire composition would color it red.

With These Tools Many Earn \$3500 A Year



No Extra Charge For This Outfit

WITH tools just like these many earn \$2500 to \$3500 a year—even more. All you lack is the training. That too I can give you, right in your own home. Keep on working at your job. Just give me a few of your spare hours. With my remarkable, practical method, I will soon make you a draftsman. Then you can take your place among the tens of thousands of well paid men who have found draftsmanship a sure road to success. Right now is the time to start. A tremendous era of prosperity is just ahead. Right now the papers are full of advertisements calling for skilled men. No chance for the man who wants to learn "on the job"—but more and more opportunity for the man who is trained.

Mail Coupon for My Great Special Offer

I am ready to do a great deal for ambitious men. Write me at once. Let's figure together on your future. You'll be surprised at the wonderfully liberal offer I will make you. Money doesn't count. If you have vim, vigor and ambition I'll give you your chance to get ahead. Write me today. Put it up to me to show YOU how you can become a draftsman at big pay

**Chief Draftsman Dobe, Div. 13-67
1951 Lawrence Avenue Chicago, Ill.**

**Chief Draftsman Dobe, 1951 Lawrence Ave.
Div. 13-67 Chicago, Ill.**

Send me your Great Special Offer open now to ambitious men. Also your book, "Successful Draftsmanship." No obligation on my part

Name _____ Age _____

Address _____

Post Office _____ State _____

Are You Headed For the Junk Heap?

You know how the aviator looks over his machine before taking off. You have seen the automobile racers tuning-up before the getaway. At every railroad station you have observed the engineer and fireman oiling up the locomotive and examining the bearings. In the power house and in the shops constant inspection and supervision is given dynamos and everything that runs.

Now how about the human machine—how about you?

What attention have you paid to your body? Have you seen to it that every part, every organ, every muscle was kept fit and strong ready to function, either in performance or in warding off illness and the inroads of disease? Or have you, through ignorance, or laziness, or sheer neglect, permitted it to become rusty, faulty, weak, rheumatic, catarrhal, tubercular, debilitated, despised—a wreck ready for the junk heap—a reject such as no one respects nor admires?



STRONGFORT
The Perfect Man

your story—then I'll tell you how I can and will help you.

I Can Help You

as I have helped thousands of others in the same hopeless condition—the weak, the timid, with fits of the blues all day long and disturbing dreams at night.

Why go on feeling miserable, out of joint with the world—ostracized by men, despised by women—when there's a way out of it—a way to a newer, better life with abundant vigor, strength and happiness.

I Want To Send You MY FREE BOOK

"The Promotion and Conservation of Health, Strength and Mental Energy."

It will show you how to eliminate from your system, in a very short time, the distressing disorders which have made you feel yourself a misfit in the scheme of humanity; how to build up your body, strengthen ALL your vital organs, turn your anaemic blood into a radiant red and feel the thrill of new life coursing through your veins. It will teach you how to become FIT physically and mentally; fit for business, for society, for the home, a power among men, a pleasing personality to women. My pupils and graduates in all parts of the world will back up every word I say—you'll find photos and letters from some of them in the book. What I have done for them I can do for YOU. I GUARANTEE IT.

SEND FOR THE BOOK NOW. IT'S FREE. Fill out the coupon and enclose a 10c piece (one dime) to help pay postage. Don't delay. SEND IT TODAY

LIONEL STRONGFORT

Physical and Health Specialist for Over 25 Years

Dept. 37 Newark, N. J., U. S. A.

FREE CONSULTATION

MR. LIONEL STRONGFORT,
Dept. 37, Newark, N. J.

Please send me absolutely free enlightenment on the Promotion and Conservation of Health, Strength and Mental Energy. I enclose a ten cent piece (1 dime) to help cover postage and have marked (x) before the subjects in which I am most interested.

- | | |
|---|---|
| <input type="checkbox"/> Colds | <input type="checkbox"/> Short Wind |
| <input type="checkbox"/> Catarrh | <input type="checkbox"/> Constipation |
| <input type="checkbox"/> Asthma | <input type="checkbox"/> Indigestion |
| <input type="checkbox"/> Hay Fever | <input type="checkbox"/> Nervousness |
| <input type="checkbox"/> Headache | <input type="checkbox"/> Rheumatism |
| <input type="checkbox"/> Thinness | <input type="checkbox"/> Weak Eyes |
| <input type="checkbox"/> Rupture | <input type="checkbox"/> Weak Heart |
| <input type="checkbox"/> Lumbago | <input type="checkbox"/> Manhood Restored |
| <input type="checkbox"/> Flat Chest | <input type="checkbox"/> Poor Circulation |
| <input type="checkbox"/> Youthful Errors | <input type="checkbox"/> Round Shoulders |
| <input type="checkbox"/> Increased Height | <input type="checkbox"/> Lung Troubles |
| <input type="checkbox"/> Pimples | <input type="checkbox"/> Muscular Development |
| <input type="checkbox"/> Insomnia | <input type="checkbox"/> Great Strength |

Name.....

Age.....Occupation.....

Street.....

City.....State.....

What Set Shall I Build?

(Continued from page 59)

advisable to remove a turn or two from coil C. This is necessary only if the condenser E, when the plates are fully disengaged, fails to stop the tube from oscillating or squealing.

Other readers have inquired whether they could substitute condensers of a different capacity in the four-tube receiver. This also can be done. In fact, changes of condenser capacity always are feasible if the coils that the condensers tune are wound with the proper number of turns of wire so that the broadcast band of wave lengths can be covered.

Some radio fans have built the one-tube set with the idea in mind of later rebuilding the parts into the four-tube outfit. In such a case it would, of course, be advisable to purchase .0005-mfd. (23-plate) variable condensers.

The four-tube receiver is recommended particularly to the radio fan who wants the limit in distance-getting ability, combined with great selectivity and undistorted volume. It is not a good set for the absolute novice to attempt, but if you already have built and operated at least one receiver, you should have no difficulty in successfully completing the POPULAR SCIENCE MONTHLY four-tube receiver.

HERE is what one radio fan in Washington, D. C., writes about this receiver:

"I constructed the four-tube set according to your specifications in the July number and am securing very fine results—just the results you promised—fine tone, volume, distance, and selectivity."

"I had previously made another four-tube hook-up recommended by POPULAR SCIENCE MONTHLY, also with most gratifying results."

There are several reasons why this set is better than other four-tube circuits that operate on the same general principles. There are no moving coils to cause queer effects while you are trying properly to balance the receiver. Regeneration is obtained without changing the wave-length settings of either tuning dial. No audio-frequency current is permitted to flow through the plate coil, so that distortion from this source is eliminated. And these advantages are gained without complicating the circuit or increasing the difficulty of construction for the home radio-set builder. In fact, this receiver is easier to build than any other set using the same number of tubes and capable of giving anywhere near the same results.

The relation between sensitiveness and selectivity can be adjusted on either the one-tube receiver of Fig. 5 or the four-tube receiver of Fig. 3 by changing the number of turns in coil A. Turns added to coil A in either case will increase the sensitiveness and broaden out the tuning to some extent. This means that if you are located 50 or 100 miles from the nearest broadcasting station or, through force of circumstances, you find it necessary to use a short outdoor antenna or even an indoor antenna, the lack of sensitiveness can be made up in part by increasing the number of turns in coil A.

LEARN BY DOING
Every phase of all branches

ELECTRICITY
taught by

Actual Practice
In America's foremost and oldest institution for trade training

No Books Used
Individual Instruction
Start Any Day

Write for FREE 64-page catalog

THE NEW YORK ELECTRICAL SCHOOL
40 West 17th St., New York City

Sent for \$

Down!

STUDEBAKER 21 Jewels
The Insured Watch

ONLY \$1.00! The balance in easy monthly payments. Buy a Studebaker, the lifetime watch, direct from the factory at lowest factory prices. 21 Jewels, 8 Adjustments including heat, cold, isochronism and 2 positions. A supreme Watch value. Write for Style Book showing 99 newest, thin-model designs. Sent FREE!

Chain FREE Special offer. Write while offer lasts. Get of Advance Watch Styles beautiful style book in colors and this amazing \$1.00 down offer.

WRITE Send today for Studebaker FREE Book

STUDEBAKER WATCH CO., Dept. W23 South Bend, Indiana
Canadian Address Windsor, Ontario

Looks Like a Real AUTOMATIC \$1.28

Protect yourself from toughs and hold-up men. Most amazing automatic 4 1/2 in. long; gun-metal finish. Can't tell from real automatic until you pull the trigger and presto! you have Opera Glass, Pocket Mirror, Magnifying Glass, Telescope, Reading Glass, Mirror, Sun Dial, Compass, etc. Loads of just useful, instructive. A real protector.

Send No Money

MAKES 10 USEFUL ARTICLES

Just send name. On arrival of "Automatic" deposit with Postman \$1.48 plus a few pennies postage. Satisfaction guaranteed or deposit refunded.

Supply limited. Order now. Big Bargain Catalog sent FREE.

FERRY & CO., Dept. 1787, 3224 N. Halsted St., Chicago, Ill.

LEARN ENGINEERING

Great Demand for Practical-Technical Engineers. Big Salaries. Wonderful Opportunities. Thousands of our graduates holding responsible high-salaried positions. Practical-Technical Course from 3 Months to 2 Years in Electrical and Mechanical Engineering. Simple and Condensed Method. Faculty of Trained Experts. New Building. Extensively Equipped Laboratories and Shops. Department of Architecture. Structural and Mechanical Drafting. Degrees Awarded. Students assisted to positions. Day and Night Sessions. 23rd Year Begins Sept. 15.

Write for Catalog A—FREE

FINLAY ENGINEERING COLLEGE, Kansas City, Mo.

Learn Advertising at HOME

Advertising men are among highest paid in the world. You can learn easily and quickly at home during your spare time. Bigger opportunities now in advertising than ever before. Tremendous demand for our graduates at big pay.

Send for FREE Book. Giving interesting information and vital facts—just what you want to know about advertising. Write today!

PAGE-DAVIS SCHOOL OF ADVERTISING,
Dept. 1367 3601 Michigan Ave., Chicago, U. S. A.

How to Charge Batteries

(Continued from page 62)

trade names by the makers of storage B batteries. These devices do not ordinarily employ a transformer. Consequently they are not capable of recharging the usual 110-volt storage B battery unless the battery is cut in two sections and the charging current sent through each section separately, or both sections are connected in parallel. The reason for this is simple. The line voltage in your house generally is not much more than 110 volts, while the voltage of the ordinary 110-volt lead or alkaline type battery runs up to nearly 120 volts when fully charged.

Figure 4 shows the connections to two double-pole, double-throw switches. This arrangement permits you to disconnect the B battery from the receiver, connect it with the charger, and also put the two halves of the battery in parallel for charging. Disconnecting the battery from the receiver is necessary, because otherwise there is chance of a short circuit from the electric-light line by way of the ground wire of the receiver.

THE use of the second switch to change the battery from series to parallel can be avoided, of course, by using flexible leads from the charger and simply clipping one to each half of the battery. It will not require twice as long to charge the whole B battery this way, since the full charging current will flow through each half while it is connected with the charger.

You should use a hydrometer to determine the state of charge of the A battery, but you will find after a few months that the simplest plan, after all, is to give the A battery a charge once a week just as you wind the clock every Sunday. The battery should not be left more than two or three weeks without a charge anyway, and the amount of current put into your battery by any of the modern chargers will not harm it, even if you do charge it a few hours more than necessary now and then. In fact, an occasional overcharge is actually good for the battery.

Storage B batteries of the lead type should be recharged for about 12 hours once every two weeks to keep them in good condition. The fact that the voltage of the storage B battery still reads up to 96 volts does not mean that the battery is not in need of a charge.

There is just one other vitally important point and that is: Be sure to keep the level of the solution in the battery above the tops of the plates at all times by the addition of distilled water whenever necessary.

STEALING radio programs may be the next crime. Invention of a way to fix sounds broadcast by radio on records was announced recently in Vienna, Austria. The broadcast sounds are recorded on disks on a spiral consisting of a continuous line of points more or less strongly magnetized, according to the strength or quantity of sound. The records may be played later any number of times. The disks may be demagnetized by a simple process and used again.

At Last The Best Encyclopaedia At a Price within the Reach of Everyone

Now the consideration of price need not stand between you and your first choice in reference works. For the best can be yours in a new edition at an unprecedentedly low cost.



A new edition of America's greatest reference work gives you the latest and most complete encyclopaedia in a new form that makes possible an amazing saving in cost.



The New Popular-Priced Edition of THE NEW INTERNATIONAL ENCYCLOPAEDIA

A new 13-volume edition printed from the same plates and identical in every way with the regular 25-volume edition except for carefully planned economies in manufacture that make it possible to offer it at an amazingly low figure. It includes the recent Supplement that has made The New International the most modern and complete encyclopaedia in existence, covering all the world's knowledge right down to the present.

Mail Coupon for Free Booklet
with specimen pages, illustrations, etc., and full information about the regular 25-volume edition and also the new Popular Priced Edition, in 13 volumes.

DODD, MEAD & CO. NEW YORK.

Dodd, Mead & Co.,
449 Fourth Ave., New York

Send me, without cost or obligation, your free 80-page booklet and full information about The New International Encyclopaedia and the new Popular-Priced Edition. (Pop. Sc. Monthly 10-25.)

Name.....
Address.....

DRAW CARTOONS
TURN YOUR TALENT INTO MONEY
Cartoonists earn from \$50 to \$300 per week—some even more. Remarkable new *Circle System of Drawing*, teaches you in half the usual time. Send 6c in stamps for free booklet and complete information. Write today.
THE NATIONAL SCHOOL OF CARTOONING
415 Park Building Cleveland, Ohio.

Play "JAZZ" on the Saxophone
Become a musician so quickly as to astound everyone. Learn by playing real music—instead of tiresome exercises. You'll soon become the most popular person in your "set".
New Easy Method
is a revelation. Nothing else like it for thoroughness and rapidity. So simple that young and old find it easy to play with amazing skill. No "trick music"—but actual notes, learned quickly right in your own home.

Learn to Play Any Instrument
Piano Mandolin
Organ Harmony and Composition
Violin Drums and
Banjo Traps
Clarinet Sight Singing
Flute Ukulele
Harp Piccolo
Cornet Trombone
Cello Saxophone
Guitar Piano Accordion
Voice and Speech Culture

U. S. SCHOOL OF MUSIC, 810 Brunswick Bldg., N. Y. C.
Send me your amazing free book, "Music Lessons in Your Own Home." Introduction by Dr. Frank Crane, also, Demonstration Lesson. This does not put me under any obligation.

Name.....
Address.....
Instrument..... Have you this inst.?

More Money for You in RADIO
Learn Electricity in CALIFORNIA

BIG-PAY jobs now waiting for young men who complete NATIONAL training. Employers say "National turns out thoroughly trained men!" Over 16,000 successful graduates endorse NATIONAL practical training methods. Expert instructors. You learn by actual work on half-million dollars worth of new equipment. Short, easy courses. All electrical trades taught including Commercial Radio Operating. Earn while learning. Train in the wonder city—Los Angeles—in heart of huge hydro-electrical development.

Write for this fascinating free catalog. It tells you how to be a high-paid Electrical Expert. Address: National Electrical School, Dept. 600, Los Angeles, Calif.
FREE ELECTRICAL CATALOG
NATIONAL ELECTRICAL SCHOOL
LOS ANGELES, CALIF.



Automobile Experts in Demand

Study with the same school that helped to train many leading men in the automobile industry

THE best proof of the value of the home-study courses of the International Correspondence Schools is the success of I. C. S. students. This success is especially apparent in the automobile industry.

Jesse G. Vincent, Vice-President of the Packard Motor Car Co., is a former I. C. S. student. So is Walter P. Chrysler, President of the Chrysler Motor Corporation. E. V. ("Eddie") Rickenbacker, Vice-president of the Rickenbacker Motor Car Co.; J. V. Whitbeck, President of the Cleveland Automobile Co.; Hiram Walker, Chief Engineer of the Chandler Motor Car Co., and John Moore, designer of the famous Ansted Motor, are also former I. C. S. students.

The first step they took was to mark and mail an I. C. S. coupon similar to the one printed below. Make your start the same way and make it right now. We'll gladly send you complete information about the I. C. S. Automobile Courses or any other course in which you are interested.

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 7668-D, Scranton, Penna.

Oldest and largest correspondence schools in the world

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject before which I have marked an X:

- | | |
|---|---|
| <input type="checkbox"/> Complete Automobile Course | <input type="checkbox"/> Gas Engine Operating |
| <input type="checkbox"/> Automobile Electric Equipment | <input type="checkbox"/> Complete Gas Engine Course |
| <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Architect |
| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Architects' Blueprints |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Contractor and Builder |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Architectural Draftsman |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Concrete Builder |
| <input type="checkbox"/> Railroad Positions | <input type="checkbox"/> Structural Engineer |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Chemistry |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Metallurgy | <input type="checkbox"/> Airplane Engines |
| <input type="checkbox"/> Steam Engineering | <input type="checkbox"/> Agriculture and Poultry |
| <input type="checkbox"/> Radio | <input type="checkbox"/> Mathematics |
| BUSINESS TRAINING COURSES | |
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Advertising |
| <input type="checkbox"/> Personnel Organization | <input type="checkbox"/> Better Letters |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Show Card Lettering |
| <input type="checkbox"/> Business Law | <input type="checkbox"/> Stenography and Typing |
| <input type="checkbox"/> Banking and Banking Law | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Accountancy (including C.P.A.) | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> Nicholson Cost Accounting | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Common School Subjects |
| <input type="checkbox"/> Private Secretary | <input type="checkbox"/> High School Subjects |
| <input type="checkbox"/> Spanish | <input type="checkbox"/> French |
| <input type="checkbox"/> Illustrating | |

Name.....

Street.....

Address.....

City..... State.....

Occupation.....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal

ELECTRICITY

COMPLETE COURSE FOR HOME STUDY \$10

HAWKINS ELECTRICAL GUIDES, 10 Numbers \$10. Complete study course with questions and answers. Teaches entire subject of practical, modern electricity. Plain language, clear diagrams, 3500 pages, 4700 illustrations. Authentic, highly endorsed—help you to better position and pay. Free examination. \$1 a month if satisfied. Send today!

Theo. Audel & Co., 65 W. 23d St., New York City
Please send me examination free coupon and full particulars about Hawkins Electrical Guides

Name.....

Address.....

Some Tire Secrets

(Continued from page 66)

the extra expense incurred in the change."

"But I thought balloon tires made such easy riding that you could go right up over curbstones or roll over a brick on the road and hardly notice any bump."

"Not with balloon tires as they are made today," said Gus. "That applied to the early models, which looked like overgrown doughnuts and carried air at a pressure as low as 20 pounds. They rode like a feather bed, but picked up all the nails in creation, the car shimmied all over the road if you drove it fast, and the gasoline bill went up and up. The balloon tires they are making today are really a compromise between the old-fashioned oversized cord tire and the true balloon."

"Of course if you were planning to keep your car for another three or four years, it might be advisable to change because of the slightly better riding qualities—"

"I'm going to trade it in next season," Conklin broke in.

"That settles it," said Gus. "Come around for your new tire in the morning. Don't forget to ask me for an old spring leaf for a tire iron."

"Looks like it's too late to do any house-hunting this afternoon, Joe," he remarked, as Conklin drove off. "We ought to get back now and see how many gallons of gas Bill has sold."

JOE agreed and when they rolled up to the garage it was to find Bill engaged in conversation with a man who was just climbing in his car preparatory to driving away.

"Howdy, Mr. Perkins," called Joe. "Anything we can do for you?"

"Sure," said Perkins; "you can make me out a receipt in full for this bill for \$124.50 I owe you."

Joe got busy at once and Gus strolled over to Bill.

"How did you make out, son?" he inquired.

"I'm some gas salesman," said Bill.

"A whole gang of motor-campers who were traveling together stopped here and I filled their tanks while they ate up all the hot dogs down at Jerry's stand."

"Well," said Gus to Joe, who had strolled over, "that's once, anyway, when we made money by trying to neglect business! Let's take a whole day off tomorrow!"

DEATHS caused by automobiles and other motor vehicles in 1924 reached the appalling number of 19 for every 100,000 of population. In the 58 principal cities of the United States, the increase of deaths was more than 100 over the record of the preceding year. The largest number of deaths occurred in New York City, where 1001 lost their lives. This prodigious toll is the excessive price we pay for growing carelessness.

METHANOL, a new synthetic alcohol imported from Germany for fuel, is as dangerous as wood alcohol to life, Professor Reid Hunt, of Harvard University, warns. Used improperly as a beverage or adulterant, it will cause blindness or death as quickly as wood alcohol.



High School Course in 2 Years

This simplified, complete High School Course—specially prepared for home study by leading professors—meets all requirements for entrance to college, business, and leading professions.

20 Other Courses

Over 200 noted Engineers, Business Men, and Educators, helped prepare the special instruction which you need for success. No matter what your inclinations may be, you can't hope to succeed without specialized training. Let us give you the practical training you need.

© A. S. 1925

AMERICAN SCHOOL
Drexel Ave. and 58th St.
Dept. H-775 Chicago

Money Back When You Finish If Not Satisfied

American School, Dept. H-775,
Drexel Ave. and 58th St., Chicago

Send me full information on the subject checked and how you will help me win success in that line.

- | | |
|---|--|
| <input type="checkbox"/> Architect | <input type="checkbox"/> Electrical Engineer |
| <input type="checkbox"/> Building Contractor | <input type="checkbox"/> General Education |
| <input type="checkbox"/> Automobile Engineer | <input type="checkbox"/> Lawyer |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Machine Shop Practice |
| <input type="checkbox"/> Structural Engineer | <input type="checkbox"/> Mechanical Engineer |
| <input type="checkbox"/> Business Manager | <input type="checkbox"/> Steam Engineer |
| <input type="checkbox"/> C. P. A. and Auditor | <input type="checkbox"/> Sanitary and Heating |
| <input type="checkbox"/> Bookkeeper | <input type="checkbox"/> Surveyor and Mapping |
| <input type="checkbox"/> Draftsman & Designer | <input type="checkbox"/> High School Graduate |

Name.....

Address.....

The Finger Print on the Gun



Two shots rang out in the darkness with but a single report. One found its mark in the heart of an innocent man. The other crippled the gun arm of the murderer. A thrill-escape through a cordon of police. But behind lay the murderer's revolver with the telltale finger print clearly impressed on the smooth, blued steel.

Almost every paper tells of the exploits of the Finger Print expert, the master detective. Why don't you—

Be a Finger Print Expert

More men are needed every day. But only trained men are wanted. We will train you at home in your spare time, as we have trained many of America's greatest experts.

Big Money to Experts Big salaries are paid. Rich rewards offered for "wanted" man. Unlimited opportunities for a professional business of your own.

Special Offer Now Write at once. Get full details. Also our Free book on Finger Prints, full of true stories of crime mysteries solved by our graduates. Professional Outfit and course in Secret Service Intelligence included without extra charge if you enroll now. Write today.

University of Applied Science
1920 Sunnyside Ave., Dept. 13-67, Chicago

COPY THIS SKETCH

and let me see what you can do with it. Cartoonists trained by this school are earning from \$30.00 to \$200.00 or more per week. The Landon Picture Chart Method of teaching makes original drawing easy to learn at home in spare time. Send sketch with 6c in stamps for sample chart to test your ability and long list of successful students. Please state age.

THE LANDON SCHOOL
1451 National Bldg., CLEVELAND, O.



A FILE Stop Forgetting NOT A FILE

Make Your Mind an index from which you select facts, figures, names, faces. Develop concentration, self-control, overcome forgetfulness. Write today for FREE memory and concentration test and illustrated booklet, "How to Remember."

PROF. HENRY DICKSON
Dept. 929, Evanston, Ill.



This One



8QJQ-BPT-DRXY

Send for this RADIO BOOK FREE

**The World's
Largest Exclusive
Radio Mail Order House
Will Send You This Wonderful Book FREE**

64 illustrated pages containing thousands of bargains in radio sets, semi-finished sets and radio kits of all styles, sizes and approved circuits. **5 tube complete sets as low as \$29.50.** Beautiful models of the very latest designs and types. Elaborate console models with loud speakers built right into cabinets of genuine mahogany and walnut. **ALL SETS GUARANTEED.** Coast to coast receiving range. Catalogue also contains everything in radio supplies, including batteries, chargers, loud speakers, transformers, condensers, rheostats and any other parts you may want for improving your set or building a new one. **Guaranteed saving to you of 1/3 to 1/2.**

Wonderful Five Tube Bargain

Sensational Offer! 5 Tube Radio Set REGULAR \$75.00 VALUE. Our large quantity production enables us to sell this set for ONLY \$29.50, fully built and wired in beautiful mahogany cabinet of latest design with sloping Bakelite panel of Satin finish, handsomely etched and engraved as illustrated. Constructed of the finest low-loss condensers, coils and sockets, bakelite baseboard, panel and dials. PRICE FOR SET ONLY. **\$29.50**

This Set with All Accessories, Including The Famous American Bell Loud Speaker

with adjustable unit, 2-45 volt "B" batteries, one guaranteed 100 Ampere Hour storage "A" battery, cable for battery connection, 5-201A tubes, Aerial and ground equipment, and everything complete ready to set up and operate. Nothing else to buy. PRICE **\$59.75** Transportation charges extra. Shipping weight 100 pounds. Complete instructions with set.

1926 Catalog of RADIO BARGAINS Save 1/3 to 1/2

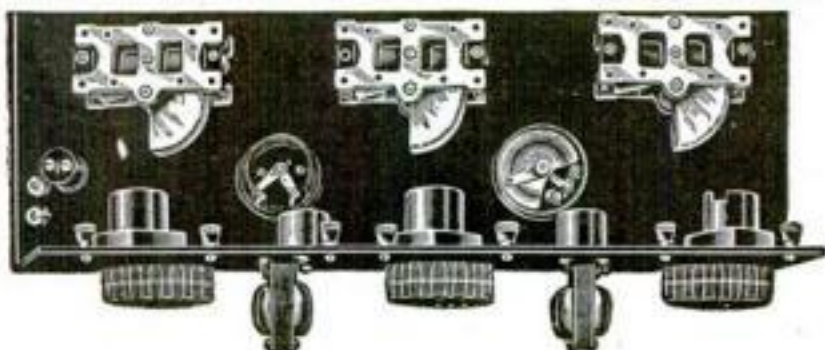
**AMERICAN
RADYNOLA
5 TUBE SET**

\$29.50



Order Direct From This Page! Save 1/3 to 1/2. Our guarantee protects you. Money cheerfully refunded if you are not satisfied. Write your order and prices plainly. Send post office money order or bank draft for full amount to insure safety. Refer to any bank or commercial agency regarding our reliability.

Semi-Finished 5-Tube RADIO FREQUENCY RECEIVING SET

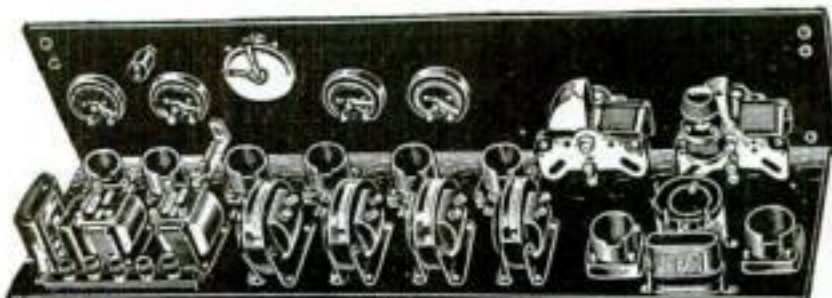


This special offer is astounding the radio world. Coast to coast reception on loud speaker. Low-loss condensers and sockets. Highest quality transformers. Bakelite rheostats. All wiring concealed under Bakelite baseboard. 7 x 18 panel fits into any standard 7 x 18 cabinet. Complete instructions for operating. **GUARANTEED SAVING TO YOU OF \$50.00.** Price of set all mounted. Not wired. **\$18.75** Cabinet of same model as American Radynola pictured above \$5.65 extra.

You must have our catalog no matter what set or kit you want. Our line is complete and includes all popular sets, such as Superheterodyne, Neutrodyne, Ultra-dyne, Reinartz, Regenerative, Radio Frequency, Browning-Drake, Reflex and all other latest circuits. Kits, sets and parts manufactured by all well known manufacturers such as Frost, Howard, Baldwin, Brandes, Western Electric, Columbia and others.

Our semi-finished sets come with all parts mounted on panel and baseboard ready for wiring. Do not fail to send for our catalog. Remember—we are the largest exclusive radio mail order dealers in the world and carry the best of everything in radio. We save you 1-3 to 1-2 on the following kits. Detailed description appear in our catalog.

Semi-Finished 8-Tube Super-Heterodyne



World's famous 8-tube Super-Heterodyne

Fully mounted on panel and baseboard. These pictures show interior set and how it looks when enclosed in cabinet. Comes completely assembled ready to wire and operate. We have testimonials from thousands of builders of this set. **Some Have Received Foreign Stations on Loop Aerial.** Unsurpassed in volume and tone quality. Low-loss straight line frequency condensers, vernier dials, finest quality rheostats. Matched Henkel or Columbia long wave transformers. Requires only three screws for attaching panel and baseboard and set is ready to operate. 7x30 panel. Price of set only.

Requires following accessories to complete this set, 7x30 cabinet, 5-201A tubes for storage battery operation or 199 tubes for dry cell operation. 100 Ampere hour storage battery, 2-45 volts "B" batteries, loud speaker, center tapped loop aerial. All these items are listed in our catalog at a tremendous saving.

\$43.75

NEUTRODYNE

Genuine Licensed Neutrodyne kit of parts come fully assembled on the panel and baseboard with complete instructions ready to wire.

\$29.75

OUR GUARANTEE

Every article exactly as represented. Every article is tested before shipping. Complete satisfaction or money cheerfully refunded.

COCKADAY

3-tube Cockaday kit of parts, fully assembled on panel and baseboard, ready to wire.

\$15.85

REFLEX

4-tube Acme Reflex does the work of 7. Fully assembled on panel and baseboard, ready to wire.

\$38.65

ULTRA-AUDION

One-tube Ultra-Audion. Wizard of radio. Fully assembled and ready to wire, with instructions.

\$6.35

ALL SETS & KITS

described on this page shipped prepaid east of the Rockies, not including Canada. American Radynola 5-tube radio frequency receiver shipped charges collect.

OUR CATALOG

includes complete list of broadcasting stations and general information and facts about our free service division. Our radio engineers will help you solve all your radio problems. Send your name and address on a card or in a letter. We will send catalog FREE.

RANDOLPH RADIO CORPORATION

159 N. Union Ave.

Dept. 15

Chicago, Illinois

Use ®

Allen-Bradley Perfect Radio Devices for maximum selectivity and noiseless control

- 1—Bradleystat**—Noiseless Rheostat for ALL radio tubes.
- 2—Bradleyswitch**—Compact Switch for receiving sets.
- 3—Bradleydenser**—Low Loss Condenser for sharp tuning.
- 4—Bradleyometer**—Perfect Potentiometer for all circuits.
- 5—Bradleyohm**—Adjustable Resistor for every application.
- 6—Bradleyleak**—Adjustable Grid Leak of highest efficiency.
- 7—Bradleyunit**—Fixed Resistor for Resistance Amplifiers.
- 8—Bradleynier**—Vernier Knob, easily attached to any set.

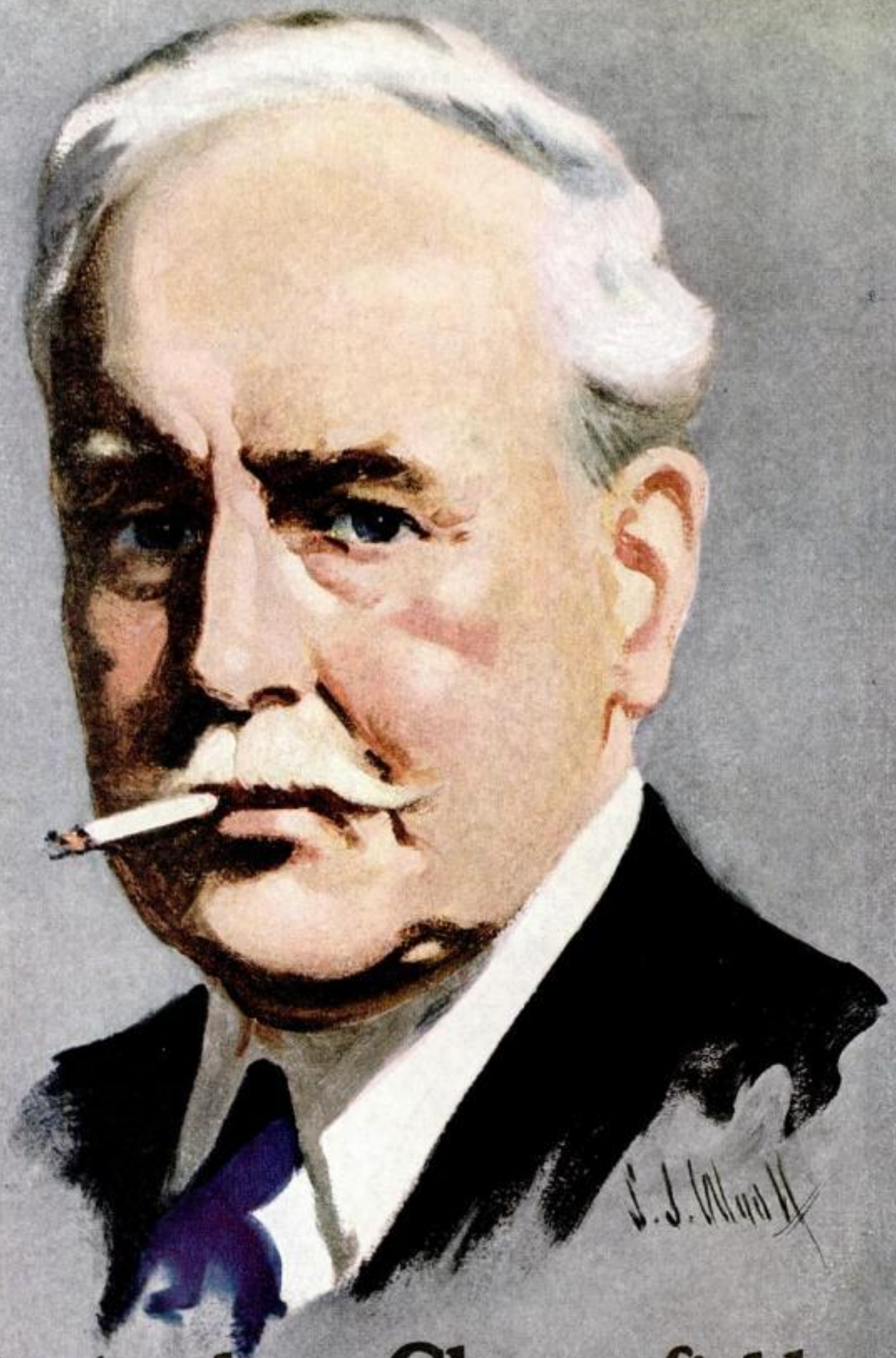


ALLEN-BRADLEY CO.,
293 Greenfield Ave., Milwaukee, Wis.

Please send me your latest literature on the
complete Allen-Bradley line of Radio Devices.

Name

Address



**On taste alone, Chesterfield
has won the endorsement of
men in every walk of life**

SUCH · POPULARITY · MUST · BE · DESERVED

LIGGETT & MYERS TOBACCO CO.

Leadership in Radio

THE nation looks to the Radio Corporation of America not only for the production of ever better Radiolas and the development of Radiotrons; not only for advances in international radio telegraphy and country-wide radio broadcasting; but for an honesty of statement that shall pierce the fog of radio claims and counter-claims with conservative promise and confidence-building performance.

Radiola Super-Heterodyne—
the most famous of Radiolas. With the new power Radiotron as its sixth tube, it achieves new *volume* of tone and finer tone quality than ever.



Radiola

AN RCA PRODUCT



RADIO CORPORATION OF AMERICA • NEW YORK • CHICAGO • SAN FRANCISCO